Engineering Record

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"In the Engineer's Judgment"

APROPOS of the editorials which have appeared in the last two issues of this journal advocating equitable general clauses in engineering contracts, the following quotation from specifications drawn up by an eminent consulting engineer is worth noting. It is but one of many examples that could be cited as to the inequity of the conditions engineers commonly impose on contractors. Following a statement that the cement for the work in question should pass the standard tests of the American Society for Testing Materials comes this sentence: "The engineer also reserves the right to submit the cement to any additional kind of tests that in his judgment may be essential and to reject any cement that is found by him to be unsatisfactory." In other words, after the contractor has purchased all of his cement to comply with the definitely stated conditions he may at any moment be put to a large loss merely because the engineer has discovered some new kind of test. How can the engineer lay claim to judicial position in the enforcement of contracts and specifications when he will allow himself to write such clauses as the one quoted?

Society Service

IN THE April "Journal" of the Boston Society of Civil Engineers there appears an article on service for the society by Edmund M. Blake, in which he lays special emphasis on the thought that membership in a society should carry with it not only the privilege of receiving something, but also the duty of giving service to the society and to the profession. Extracts from the paper appear on page 580 of this issue. Mr. Blake says: "We cannot draw from a bank unless we have put in something to draw upon, and the more we put in the more we can draw out. * * * With this conception [a true spirit of service] firmly established in his mind, the engineer who joins a society will consider of first importance the question of what he can add to the society and not of what he can get out of the society in return for his annual dues. Service for the society will follow, and soon there will be no need of arguing the other side—that of the benefits to be received from membership in the society." Mr. Blake's words may well be taken as a supplement to the editorial "Service of Engineering Societies," which appeared in the Engineering Record of April 1 and which has caused considerable comment. Societies well may ask themselves whether they are affording full opportunity for their membership to be of service to the organization and to the profession. The easy answer is that everyone is invited to prepare papers, but that answer merely dodges the issue. Many will serve when drafted for service who would not volunteer to help.

Co-operation in Chicago

ENGINEERING societies in Chicago are working together for the common good to an increasing degree. Last week the Western Society of Engineers opened its doors to perform a national service. It will be the headquarters of the representatives of national societies engaged in the industrial census of the Naval Consulting Board, and will lend the services of its secretary and staff in the prosecution of the work. The Western Society of Engineers is an "inclusive" organization, and it is worth noting that the members of the Illinois committee, representing the national civil, electrical, mechanical, mining and chemical organizations are on its membership roll. Such a large opportunity to serve the nation comes at infrequent intervals and it was, therefore, eagerly grasped. Another instance of the co-operation spirit in Chicago is afforded by the support given the course of military lectures which was started April 20. Only through united effort could the committee, which is more or less self-appointed, have financed the course.

Short Highway Courses

SHORT courses in highway engineering have proved their usefulness. This is the consensus of opinion of the officers of the schools which have held them and also of the men who have attended. The Engineering Record has obtained opinions from the heads of the civil-engineering departments of various universities which have conducted such courses and a brief compilation of these views is published on page 586. Without a dissenting voice they agree that the courses serve a useful object. One believes that better results would result if the courses were shortened to three days. Another expresses the opinion that intermediate sessions should be held at local points. A third states that he is considering just such a step. The short highway courses have evidently proved their value. They have attracted and held all classes interested in highway work—the engineer, who designs and oversees, and the contractor, who executes. Better roads will undoubtedly follow in the sections favored by these courses. The suggestion regarding intermediate courses at local points has in it the germ of great possibilities, but the step must be considered carefully. It is the shortness of the courses that now attracts the roadbuilder. If the number of sessions be increased he may be kept away, thus defeating the very object of this growing and needful educational service.

Wooden Shingles Again

CLOSELY connected with the lessons to be learned from the great fire in Paris, Tex., pointed out in the article on page 572 of this issue, is the old story of the tremendous fire hazard of the ordinary shingle roof. There is little doubt that this conflagration, ranking among the big fires of recent years, with losses exceeding $10,000,000, could have been confined within a small area if the high wind had not carried burning shingles for blocks to ignite other buildings having shingle roofs. Of the total number of 1440 buildings destroyed, over 1000 had shingle roofs. Perhaps no more convincing example of the danger in the use of untreated wooden shingles in a closely built up community could be found than that furnished by this latest conflagration. Practically the only residence in the path of the flames which was but little damaged was roofed with incombustible material. In the reconstruction of the city the use of wooden shingles without fire-retardant treatment should be absolutely prohibited. This journal believes that this unnecessary fire hazard from shingle roofs should be eliminated by law in all large towns, as it has already been eliminated in the larger cities.

Novel Tunnel Practice

IN DRIVING the 8-mile Wilson Avenue waterworks tunnel in Chicago, a day labor job, described on page 568 of this issue, the city engineer's forces have introduced an extraordinary feature. Muck is carried back from the heading a short distance, sized by means of a screen and used for making the concrete lining, the whole operation taking place within the bore. Large pieces of rock, rejected by the screen, are hauled to the surface through the shafts and disposed of, but the fine material blasted out is put back again into the lining by a pneumatic placing outfit without ever emerging into daylight. Thus the operations of tunneling and lining are carried on simultaneously and part of the heading muck is returned to the work. It is expected that the work will be finished a year ahead of the estimated time. Of course, such a scheme is not susceptible of general application. Not every tunnel passes through rock which is suitable for use as concrete aggregate and certain formations could not be depended upon to break to sizes which would supply a sufficient quantity of small-size material for concrete making. The Chicago engineers, however, present records which indicate that the methods they are using on the Wilson Avenue work are saving both time and money.

Municipal Asphalt Repairs

THE Borough of the Bronx, New York City, has built an asphalt plant and makes its own repairs to asphalt streets. The results, as indicated by the first six months of operation, during which the work was done at a cost of more than 33 per cent lower than the lowest contract price ever obtained, as described on page 579, give promise of future economy. From the experience of the Bronx and the success of other municipally-operated plants there is no doubt as to the economy of municipally-made repairs. But a word of warning is in order. It is not the building of the asphalt plant alone that made the saving in the Bronx possible. The human element has played an important part. The generally conceded advantage of doing work by contract lies in the fact that a contractor, by employing only such men as are of value to him and by eliminating waste motion and costly red tape, is able to do work at a profit at less cost than the general run of municipalities can do it themselves. This advantage of the contractor does not apply in the case of the Bronx. For years past there has been a noticeable and increasing esprit de corps among the employees of its highway department, and a keen appreciation of the worth of subordinates on the part of the higher officials. The engineer in charge of maintenance violates in many respects the popular conception of the city employee. He is not a clock watcher or a politician. Quite frequently he is on the job at 5 o'clock in the morning, and he works Saturday afternoons, perhaps sometimes on Sunday. His subordinates are of a similar type. The Bronx has appropriated the contractor's main advantage. Results on the part of its employees count more than friendships and political affiliations. This is efficiency. Hence the saving in asphalt-repair costs.

Disciplining Society Members

WHEN 85 per cent of the membership of a society votes for a proposal one is justified in assuming that the hearty support of the membership can be relied upon in the execution of the plan proposed. That percentage, 85, was registered in the recent poll of the American Society of Civil Engineers in favor of granting to the board of direction power to discipline and to expel members. With such a clear indication of the feeling of the members there is no doubt that the revised constitution, now under consideration, will make such provision that the right of appeal to the membership at large will be denied. The present method of bringing a member to task is entirely too cumbersome and little can be expected from it in the way of raising or maintaining the society standard. But it must not be thought that the mere incorporation of this enlarged power in the constitution will entirely solve the problem of the maintenance of a high standard. The machinery must be perfected for handling cases of discipline in a well-defined and expeditious manner. A "committee on grievances" is needed, and it should be within the power of any member to bring matters to the attention of that committee. The present constitution requires that ten men join in presenting matter for discipline to the board. In fact, a grievance committee properly constituted should not wait until matters are formally brought to its attention, but should ever be on the alert to discover and act on cases in which improper conduct on the part of the membership is reflecting on the society. Possibly when the new constitution is adopted the code of ethics will become a document vital in the life of the society and will not continue, as now, a dead letter—a law without machinery for its enforcement and penalty for its violation. Eighty-five per cent of those voting have indicated that they will support the officers in the setting up and maintenance of high ethical standards. It is to the interest of the society and the profession at large that these larger powers be placed just as soon as possible in the hands of the board, and, through it, in the hands of a grievance committee.

Natural Cement

ENGINEERS and contractors will follow with interest the efforts being made by the Utica Hydraulic Cement Company to enlarge the market for its brand of natural cement, in competition with Portland. The younger generation is almost wholly ignorant of the older material. Portland has been the supreme master of the cement field for nearly 20 years. Thousands of dollars—hundreds of thousands would be more exact—have been spent in investigations of the properties of Portland, both by itself and in mortar and concrete. Committee work of the most thorough character has been carried on by the American Society for Testing Materials in developing its standard specification for Portland. All this has tended to push natural into the background. Furthermore, commercial conditions have aided to bring about the almost total eclipse of natural cement in engineering construction. The price of Portland began dropping rapidly fifteen years ago and has at times been the same as natural. Then for long periods the difference in price would be so small that engineers were glad to pay the slight excess for the better-controlled product. The aggressiveness of the Portland manufacturers was also a factor, the remarkable advertising and publicity methods helping to keep the advantages of the higher-class product before the users and their engineers.

And yet the older product had much merit. Slow setting, low strength and variability in composition were the disadvantages charged against it. Important structures built of it—dams, aqueducts, buildings—have given satisfactory service. Its use in aqueducts and buildings was largely as mortar for the masonry. Undoubtedly there is still a field for it—in the mortar for brick and stone work and in some forms of mass construction. Its low strength and slow setting rule it out in reinforced work, while the setting will count against it wherever forms are much of an item.

The progress that will be made in recreating a market for natural cement is impossible to predict. With present prices of Portland and natural, there will be temptation to use the latter where its use is permissible. On the other hand, engineers are naturally slow to turn from present standards, particularly when the alternative material is confessedly inferior in important qualities. Fundamentally, then, the progress of natural will depend upon price. Should the margin between it and Portland remain large for a considerable period an increase in its use can be looked for.

The Bond Articles and Military Preparedness

IN this week's issue appears the ninth and final article of Major Bond's series, "National Defense—for Engineer and Contractor," which was begun in the issue of March 4. The concluding chapter, on page 575, discusses the qualifications of engineers and contractors to meet the military obligations of citizenship, and suggests methods of increasing their efficiency as part of the program of national defense.

When the publication of such a series of articles was conceived, following General Wood's address before the Brooklyn Engineers' Club last December, the civil engineer's interest in military preparedness was a negative quantity. In some quarters there was grave doubt as to the wisdom of publishing military articles in a technical paper devoted to civil engineering and contracting. The enthusiastic response to the series is a convincing answer to the pessimistic. It is conservative to state that Major Bond's contributions have been the most widely read articles ever published in an engineering journal. The paper which best serves its readers is the one with vision—with the ability to sense the big event while it is still in the formative stage and to plan a campaign which will not merely reflect the interest of the profession along the new line, but stimulate it. How many technical men a year ago would have taken seriously a prediction that the members of the profession would soon be appointing military committees, organizing military lectures, participating in preparedness parades, drilling and planning encampments? Yet this is exactly what has happened.

From the outset the Engineering Record has consistently employed every means available—editorials, news items and special articles—to foster a sentiment in favor of adequate measures of national defense, and it is believed that these efforts have been no small factor in awakening the profession to a realization of its military obligations. Major Bond's series is ended, but the momentum of the movement which it was designed to stimulate is sweeping the country with a force that is gaining in strength every day.

British Aid to Research

THE terrible stress of the European war has forced upon public attention the need of swift and efficient investigation into the production of many things which are demanded for national protection and convenience. Every one of the combatants has undertaken actively in one way or another to develop the technical as well as the military and naval resources of the country. In particular, England has done a very interesting thing in setting up the Advisory Council for the Organization and Development of Scientific and Industrial Research. It is a body which has to look to the general treasury for funds and be responsible to the Privy Council for the administration of them, but it has authority to do things in a large way. Results are already appearing, although the council was set up hardly more than nine months ago.

The opening of the war found England terribly dependent upon Germany for technical supplies, which when cut off left a wide gap which must somehow be filled. The same condition applies now to this country, save for the impelling necessity of war, since many materials once imported must be made at home. It is high time for the Government to take an active hand in the work. It is because Germany has done precisely this, and in advance of necessity, that German technical industry has advanced to a point where the world was dependent upon it. The scientific departments of the United States do splendid work in spite of inadequate appropriations and the United States might well afford to increase the activities of its already organized institutions tenfold.

The English advisory council, however, works along broader lines, driven by the necessity of prompt action. It not only liberally supports governmental activities, like the National Physical Laboratory, but also works in co-operation with independent technical bodies, making the necessary appropriations to carry out important work immediately. The council is co-operating at the present time with eight or ten technical bodies, including, for instance, the institutions of mechanical, electrical and gas engineers, to enable them to push forward necessary work in the most direct and efficient way. The very first result has been to put the country in the way of getting out of the very grave difficulties met from the lack of optical and laboratory glass.

A word about the way in which the work is handled. The advisory council is composed of seven distinguished scientific men, with Lord Rayleigh at their head, and with a small administrative organization. It is assisted by sub-committees of experience, in part nominated by the council and in part by the several industries with which they are closely concerned, thus resembling the co-operative efforts of our Bureau of Standards. It is the policy of the council to keep in touch with the development of industry through these sub-committees and to be ready to extend instant help to any deserving case. This particular organization seems excellently suited to obtain instant contact with important problems without the council itself being perpetually beset by hopeful investors. Moreover, the English body is getting after results by the quick route of utilizing existing facilities. Laboratory equipment is to be found in many places, and the advisory council has been glad to utilize it without drawing upon its appropriations for anything beyond working funds. The right men are of more importance in industrial research than elaborate quarters and costly equipment, and the advisory council has been apparently pre-eminently successful in going after and getting the talent necessary to do the work.

The main thing in the whole movement is to obtain speedy results in solving technical problems important to the needs of the country, and for this purpose the English organization has proved itself well adapted.

Signs of Progress in Haiti—The Engineer's Interest Therein

EDITORIALLY this journal stated, in the issue of Oct. 9, 1915, that if a stable government should be established in Haiti the country would offer one of the most profitable fields for engineering promotion and development known in recent years. Such a government has been practically established, and assured, under the protection of the United States. Already there are signs of progress.

The municipality of Port au Prince has undertaken extensive improvements, including the sanitation of the city and the construction of a wharf. It is said that an electric railway is to be built from the capital city to Petionville, a wonderful summer resort, high in the mountains, less than a day distant from the city for a man afoot, yet hitherto little used despite the intense summer heat of Port au Prince.

Haiti has a large population in proportion to its size. It has natural resources and possibilities of almost incalculable value. But the country possesses none of the improvements of modern civilization. This is not unnatural. Previous to the landing of American marines last year, there were few men of influence sufficient to bring about public improvements who could with assurance state that they would not be exiled or meet with a violent death within the month. So why bother about the peril of an epidemic when that of the firing squad was so much more imminent!

Now that they are relieved of such anxieties, their minds turn naturally to the inconvenience, discomfort and danger of their surroundings. Those possessing vast tracts of land, now wildernesses, but potentially the richest sugar-growing soil to be found, are going to realize why it is that they are land poor, while almost within range of the naked eye, on a clear day, are the mountains of an island in which property owners are growing rich from the products of a soil that is considerably less fertile than theirs. The answer in all cases is improvements; improvements possibly at a rate and on a scale, when taken in relation to the area of the country, never before known. The demand is just beginning to be felt. Soon it will become insistent.

And here, as everywhere, material progress means but the solution of engineering problems.

Steering a Straight Course in Valuation

NO SUBJECT that comes within the scope of the civil engineer to-day requires clearer thinking than that of valuation. The interests at stake for the consuming public, and in a double sense for that part of it which holds investments in public utilities, are tremendous. Variations of 10 per cent in small items, when multiplied by the hundred thousands and the millions to represent their aggregate occurrence on, for example, the railroad lines throughout the country, give exceedingly large figures. The questions of property appreciation, depreciation, development expense, land values—all have a material bearing on the end results.

Were everyone thinking sanely, the problem, such is its complexity, would be difficult enough. Unfortunately, lawyers and economists with little practical experience in railroad management, engineering or finance have been called into the problem. There has resulted a variety of theory that is bewildering to all but those who have the knowledge and strength to cling close to fundamentals, despite every "wind of doctrine." Silly are some of the theories, vicious others, while many seem to be framed merely to get, despite the equities in the case, as much as possible for the side advancing the argument.

In this bewilderment it is needful to steer straight. It is necessary to be unafraid, and to rap each unsound theory that comes from a sufficiently noted, or better, notorious, source to give it standing. New theories must be judged from the standpoint of sound principles and must be rejected if they run counter thereto.

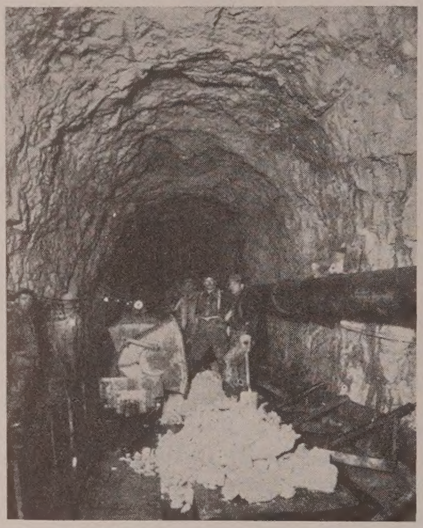
Much of the bewilderment has undoubtedly been due to the desire of many who are interested in or concerned with valuation work to read all the literature constantly being issued on the subject. Such a course, if one's foundation is not solid, is almost certain to lead even the conscientious astray. While it is necessary to know the chief of the erroneous doctrines in order to refute them whenever occasion affords, it is a waste of valuable time to try to follow each new theorist through his tangled logic to his absurd conclusions. Only the more important, therefore, of the erroneous and vicious theories need to be given consideration.

Cling close to the fundamentals, read carefully the writings of those who have already shown themselves to be on sound ground, be familiar with the more important of the erroneous doctrines, and neglect all the mushroom theory and literature—such is the soundest advice that can be given him who would follow valuation development and wishes to conserve his time.

Tunnel Muck Turned into Concrete Lining Immediately Behind Heading

Chicago Waterworks Engineers Drive Tunnel by Day Labor, Save City $250,000 and Utilize Special Mounted Concrete Equipment

MINE-RUN material put through a 4-in. screen plus cement makes up the concrete lining in the 8-mile Wilson Avenue waterworks tunnel which the city engineer's force of Chicago is building by day labor to provide an additional supply to the rapidly growing northwest portion of the city. The cost is going to be $250,000 below the lowest bidder's estimate and the time of completion one year under the forty-two months schedule, if present progress of 20 ft. per day is maintained. Henry W. Clausen, engineer of waterworks construction, made these estimates recently in a comprehensive paper on the project before the Western Society of Engineers. General articles on the new supply were printed in the Engineering Record of Jan. 16 and 23, 1915, pages 73 and 103, respectively. The intake crib there described has since been put in place and on April 18 the interior was pumped out ready for the sinking of the shaft. The cutting edge made a watertight joint with the clay. The following is an abstract of that part of Mr. Clausen's paper dealing with the methods used in driving and lining the tunnel.



TUNNEL MUCK WHICH IS USED FOR LINING CONCRETE

DIFFERENT HEADING METHODS TRIED

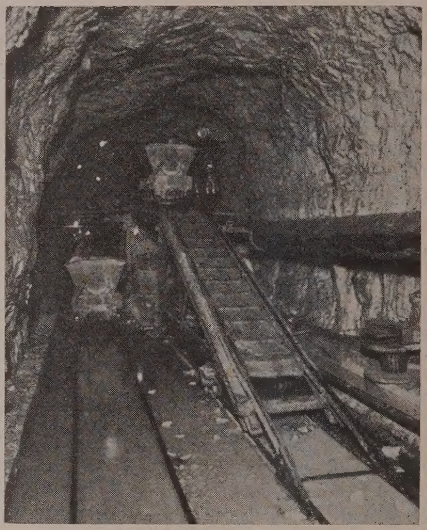
In order to obtain positive information as to which method of tunneling was the most economical, speedy and best adapted to local conditions in Chicago, it was decided to try out a number of different methods of mining. Accordingly, the standard method of top heading and bench, operating on the two-shift basis, was used at the Shore shaft—the entrance to the 3-mile tunnel under the lake to the crib—and the Lincoln Avenue and the Lawndale Avenue shafts. These shafts were selected for the two-shift method on account of the territory being more or less built up and the necessity for inconveniencing the rest of the community as little as possible. This method involves the drilling of from twenty-eight to thirty-four holes in the heading and eight to twelve holes in the bench. The cut holes are from 12 to 14 ft. deep and some 15-ft. steel was made up in order to still further increase the shot.

The bottom-heading method with break-down roof, on the three-shift basis, was used in the single heading from the Mayfair shaft. This territory was not so thickly built up and it was found that no complaints resulted from the blasting operations carried on during all hours of the day and night. This method involves the drilling of about twenty-three holes in the bottom heading and five holes in the roof heading. The cut holes are from 9 to 10 ft. deep.

BULKHEADED FORMS RECEIVE CONCRETE FROM RISING PIPE

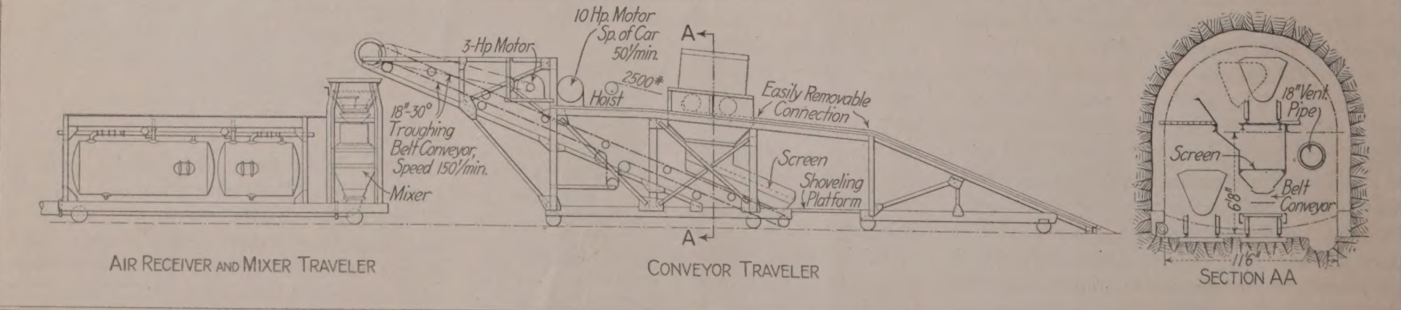
At the latter shaft an experimental shooting platform was constructed for the purpose of intercepting the rock shot down from the roof, thus avoiding blocking the free passageway to the bottom heading for a certain time while the rock from the roof was being mucked out. The platform was constructed of steel and lasted but a short time, finally becoming so badly bent as to make it of no further use. It is Mr. Clausen's belief that no such device, however constructed, will ever ultimately pay in work of this kind.

Experience showed that the top-heading-and-bench method is the most economical for this rock operated on the two-shift basis. The reason for this is two-fold: In the first place, if there is any quantity of water it is not blocked by the breakdown shot of the top heading; the second and most important reason is that on the two-shift basis a certain task can be given to the gang which must be completed before the work is left. In other words it is the duty of the miners to set up columns, drill and load their holes and shoot their rounds before going home. Likewise, it is the duty of the muckers to muck out all the rock from the previous shift. It is understood that the time of the shift ends whenever these tasks are completed.



INCLINE TO CONVEYOR TRAVELER WHICH FEEDS MIXER RIG

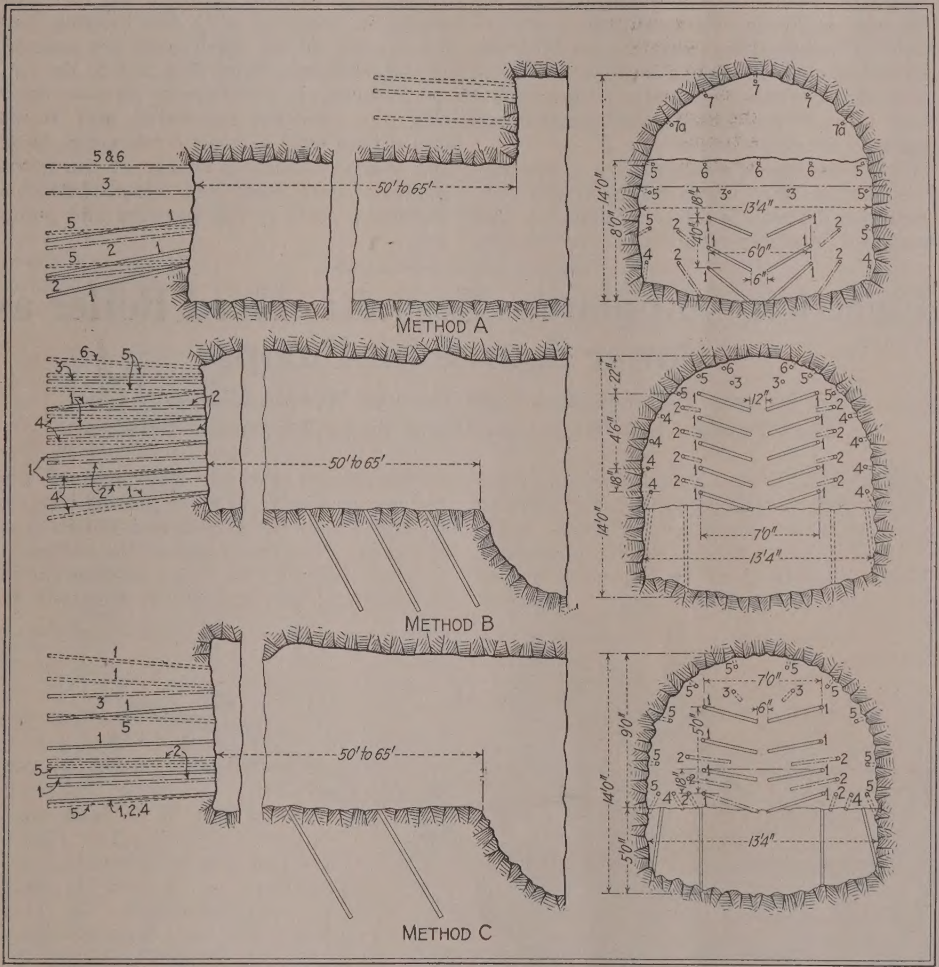
With a well-organized crew, for a 10 to 12-ft. round the muckers will complete their work in from 6½ to 7 hours and the miners in from 7 to 7½ hours. If the gang is not up to standard it may take them 9 to 10 hours, for which they only receive one day's pay. The fact that a shift can be held responsible for a definite amount of work spurs each man on to do his part.



MUCK SCREENING OUTFIT IN CHICAGO TUNNEL PUTS INTO MIXER ALL MATERIAL SMALLER THAN FOUR INCHES

Furthermore, by timing the beginning of the shifts properly a comparatively even load factor can be maintained on the power equipment.

In the three-shift method the gang only works 8 hours and quits, the succeeding shift taking up the work where the previous shift left off. If, for any reason, the previous gang neglected its work it is hard to place this responsibility without argument and question. This later fact is of extreme importance in operating under the civil service system, because absolute evidence must be forthcoming before a man can be discharged. Experience also showed that the total daily progress was not any greater by the three-shift than by the two-shift method, although a greater number of men were working with the three-shift method.



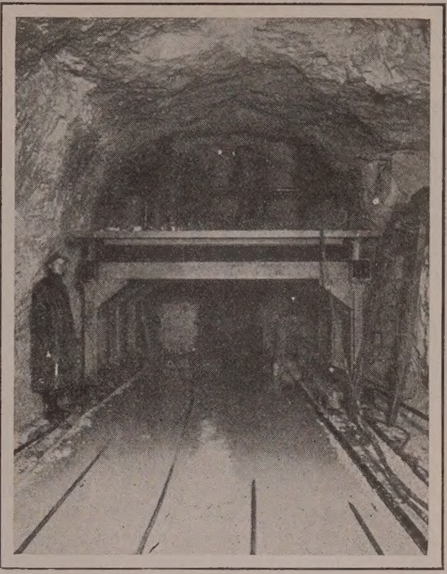
BOTH TOP AND BOTTOM HEADINGS WERE TRIED IN TUNNELING

METHOD A.—Holes 1 shot first and reloaded until cut is out. Holes 2, 3 and 4 are then shot, followed by holes 5, 6 and 7, shot at same time. All holes 10 ft. long, and loaded with 8 sticks of dynamite. No delay fuses in holes 1, 2, 4 and 7a. First delay fuses in holes 3, 5 and 7. Second delay fuses in holes 6.

METHOD B.—Holes 1 shot on first shot; reloaded and shot until cut is out. Holes 2 and 4 are then shot. Next holes 3, 5 and 6. Next holes 1, 2 3 and 5 are shot with no delay fuses. Holes 4 and 6 are shot with first delay fuses. Holes in bench are shot before heading holes. Holes 9 shot with no delay fuses; holes 10 with first and holes 11 with second. Bench and heading holes loaded with 7 or 8 sticks of dynamite. Bench holes 8 ft. long and heading holes 12 ft.

METHOD C.—Holes 1 shot first with no delay fuses; then reloaded and shot with holes 2, 3, 4 and 5 on second shot. Holes 1 on second shot are loaded with no delay fuses, holes 2 with first delay, holes 3 and 4 with second delay, and holes 5 with third delay. Holes 1 loaded with 9 sticks, holes 2 with 8 sticks and holes 3, 4 and 5 with 7 to 8 sticks. Each stick 1 lb. exploder in next to last stick. Heading holes 12 ft. and bench holes 10 ft. deep.

As an example of the increasing progress of this work it may be stated that the best average daily excavation done by contract on a 12-ft. tunnel in Chicago was about 8 ft. per 24 hours. On the Southwest Land and Lake Tunnel a progress of 15 ft. per day was made, but the excavation required so much trimming subsequently that the actual daily progress was much less than 15 ft. The average daily excavation performed by the city by the day-labor method is about 20 ft., many days being as high as 22 and 23 ft. The maximum obtained has been about 26 ft. When excavating rock at this rate a round trip of the cage would be made every 56 seconds, 7 seconds being used each at the top and bottom for loading a car. The descent would be made in 10 seconds. The bottom of the shaft at Lincoln Avenue, in order to facilitate this operation, has a spare track on one side of the cage to handle empty cars. Three hundred steel side 1 yd. K. & J. dump cars are used. They are specially designed with roller bearings and half-size automatic couplers. They are hauled by 40-hp Baldwin gasolene locomotives.



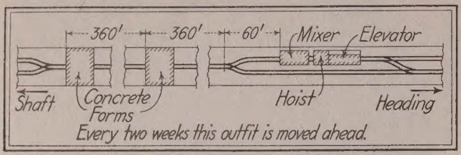
PLATFORM TO CATCH BLASTED MUCK WAS SOON BROKEN UP

The usual method previously employed by contractors in lining tunnels of this size was to excavate the drift completely previous to starting the lining of the tunnel, bringing all material to the surface where it was stored or otherwise disposed of to the best advantage. After the mining was completed the excavated rock stored on the surface was crushed and screened, mixed with sand and cement and brought into the tunnel and placed by hand behind forms of steel or wood. From 30 to 35 ft. per day were lined in this way. When the drift was long the concrete sometimes had its initial set before arriving at the forms. This method of handling was necessary on account of the restricted space, making it impossible to carry on both operations of minging and lining in the same heading at the same time. It also operated to extend the ultimate time for completion on account of having to line the entire drifts after all mining was completed.

It was noticed in the Wilson Avenue tunnel that the rock in the mine-run condition contained considerable fine material and apparently would make good concrete. Various compressor foundations and other miscellaneous concrete work on top were made with this material, showing excellent results. Test cubes, eighteen in all, were made with various proportions of cement, aged thirty days, and broken at the Armour Institute of Technology. They indicated that the concrete was of satisfactory strength. Realizing the possibilities not only of completing the work very much earlier but of saving the expense of hauling the material back and forth required for the lining, as well as the cost of purchasing crushed stone and sand for the concrete, it occurred to the engineers that a method could be devised which would line the tunnel with the mine-run rock in

BELT CONVEYOR UNDER SCREEN DISCHARGES INTO MIXER HOPPER the same drift as the mining was carried on, thus carrying on both operations simultaneously.

After considerable thought and study a scheme was worked out which would accomplish this purpose. It consists of a screening and loading machine which handled all the rock coming from the heading, permitting the material less than 4 in. in dimension to be deposited in the hopper over a pneumatic mixer. The oversize is rejected and loaded by hand into a car standing nearby. A pneumatic mixer deposits the concrete through an 8-in. pipe placed behind the Blaw steel forms especially designed for clearance, at a distance of as much as 800 ft. away. The screening machine, built from city designs by the Stephens-Adamson Manufacturing Company, and the concrete mixer, are designed to run on roller-bearing wheels operating on one track and within the clearance of the final tunnel dimensions. The concrete forms in 30 ft. sections are made of steel operating on a traveler on roller-bearing wheels. By this system approximately 60 ft. of forms are filled in two shifts, the concrete setting only about 16 hours before the forms are removed. The clearance on the forms and the concrete machinery is so arranged as to permit of unhampered operation of the trains through and past the concreting outfit.

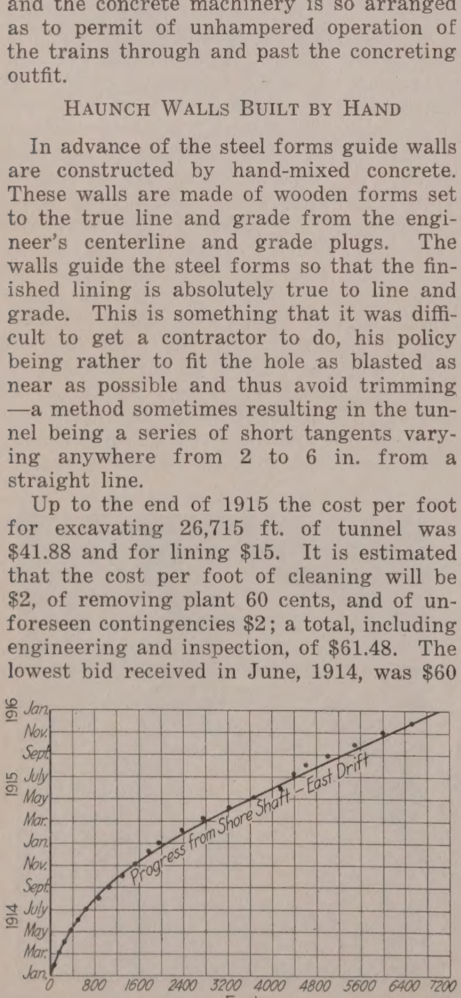


THIS OUTFIT MOVED EVERY TWO WEEKS

HAUNCH WALLS BUILT BY HAND

In advance of the steel forms guide walls are constructed by hand-mixed concrete. These walls are made of wooden forms set to the true line and grade from the engineer's centerline and grade plugs. The walls guide the steel forms so that the finished lining is absolutely true to line and grade. This is something that it was difficult to get a contractor to do, his policy being rather to fit the hole as blasted as near as possible and thus avoid trimming—a method sometimes resulting in the tunnel being a series of short tangents varying anywhere from 2 to 6 in. from a straight line.

Up to the end of 1915 the cost per foot for excavating 26,715 ft. of tunnel was $41.88 and for lining $15. It is estimated that the cost per foot of cleaning will be $2, of removing plant 60 cents, and of unforeseen contingencies $2; a total, including engineering and inspection, of $61.48. The lowest bid received in June, 1914, was $60 per foot, to which it is estimated $2 should be added for contingencies and $6.20 (10 per cent) for engineering and inspection. The saving will be therefore slightly more than the cost of the engineering and inspection, but the time will be reduced one year.



PROGRESS RECORD FROM SHORE SHAFT—EAST DRIFT

ORGANIZATION

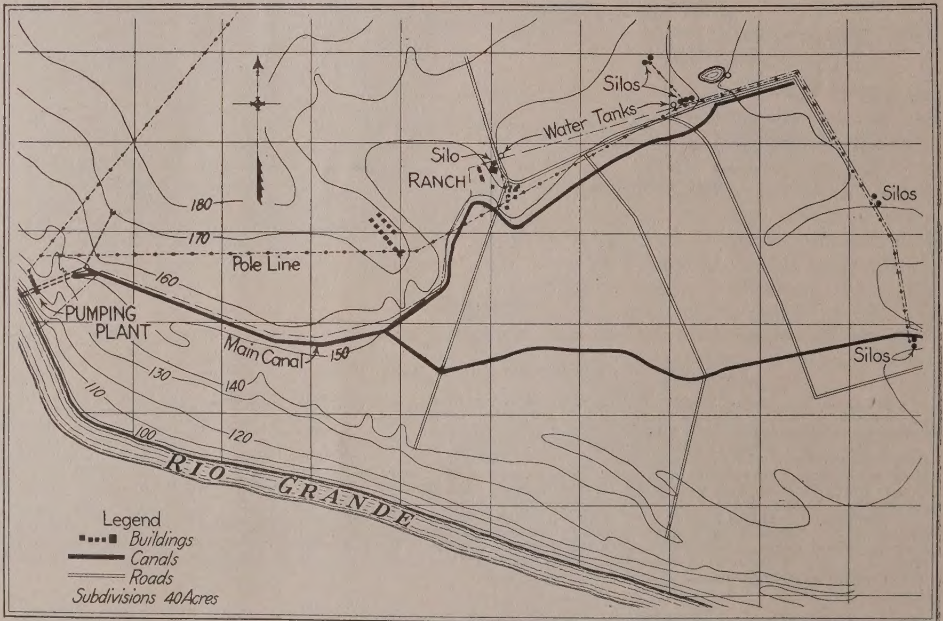
The work was planned and is being executed by John Ericson, city engineer, reporting directly to L. P. Morehouse, commissioner of public works. Directly connected with the design were M. B. Reynolds, engineer of waterworks design, and H. S. Baker, assistant city engineer. H. W. Clausen, engineer of waterworks construction, is immediately in charge of the construction division of the Bureau of Engineering. He is the general superintendent, as it were, of the tunnel as well as of other waterworks construction.

After the above, at each shaft of the tunnel, the standard organization of the construction division is followed, namely: An assistant engineer, who is in local charge of the work. Reporting to him is the tunnel foreman, who has general charge of all the labor and upon whose experience as a miner the assistant engineer naturally relies more or less. The drilling and blasting of the heading are in charge of a heading boss, who reports directly to the tunnel foreman. The miners who operate the drills and load and explode the charges placed in the borings or holes, together with their helpers, are under the immediate jurisdiction of the heading boss. The muckers working in the heading load the blasted rock into cars and are under the direction of a mucking boss who also reports directly to the tunnel foreman but of course works in harmony with the heading boss during the period when both are engaged in the heading. Reporting also to the tunnel foreman are the concrete foreman handling the concrete apparatus and forms, straw boss over a small track gang, hoisting engineers having charge of the power plants at each shaft and other unattached workmen, such as top laborers and pumpmen.

Electricity Supplants Mesquite-Fired Boiler as Power Source for Pumps

Air Chambers Absorb Back Lash Through Wooden Discharge Line When Pumps Stop—High Centrifugal Pump Efficiencies Obtained

MESQUITE as a fuel for steam-driven irrigation pumps proved the undoing of a 1000-acre project on a Texas ranch 12 years ago. Coal hauled 18 miles from Eagle Pass tried as an alternate proved too expensive and the project remained dormant until electricity revivified it in 1913. The acreage is part of a 160,000-acre ranch in Maverick County bordering for 40 miles on the Rio Grande. Provision is made to bring an additional 1500-acre tract under water from the rehabilitated pumping plant at a later date.

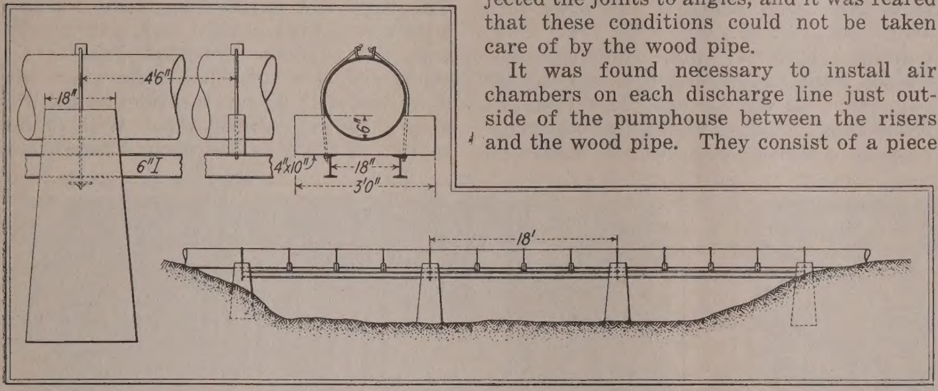


TOPOGRAPHICAL MAP OF THE INDIO RANCH SHOWING COMPLETE PLANT LAYOUT

WHY ORIGINAL PLANT FAILED

The steam pumping plant was erected at the extreme upper end of the ranch and consisted of a simple Corliss steam engine, two 125-hp. water tube boilers and a No. 16-centrifugal pump. The engines and boilers were located on the ground level, 34 ft. above mean river level and 170 ft. from the river. The pump was at the bottom of a brick-lined pit 14 x 16 ft. in plan and 25 ft. deep and was belt-driven from the fly-wheel of the engine—the position of the belt being about 45 deg. from the horizontal. Water was pumped from a sump lying directly under the pump and connected to the river by a brick gravity flow intake. The water was discharged through a spiral riveted riser into a wooden flume located over the pump house. This flume carried the water to the canal head about 600 ft. away.

The plant was more or less of a failure from the start, as the native mesquite wood for fuel proved to be costly and unsatisfactory. After a season or two of operation all the available mesquite had been used and so an attempt was made to haul coal by wagons from Eagle Pass, 18 miles distant; this proved entirely unpracticable. Then the gravity intake gradually filled with silt until it became practically useless and the plant was closed down and the irrigation project abandoned.



METHOD EMPLOYED IN CARRYING PIPE LINE ACROSS ARROYO

Decide to Install New Plant

In the summer of 1913 B. G. Barnes, general manager of the cattle company, again became interested in irrigation in so far as growing cattle feeding crops was concerned and decided to replace the old plant by entirely new equipment and structures suitable to the conditions.

After considering several types of prime movers it was decided to install electrically driven pumps and buy power from the International Electric Company of Eagle Pass, which agreed to build a power line to the ranch. The old steam equipment was dismantled and sold and the pump pit floored and lined with 6 in. of reinforced waterproofed concrete. A vertical centrifugal Worthington pump direct-connected to a 100-hp. General Electric induction motor was installed, the pump being placed in the bottom of the pit and the motor on the floor level above. The suction pipe is 160 ft. long and is a 16-in. flanged wrought-iron pipe. The discharge riser is a 14-in. wrought-iron pipe and there is a balanced check valve immediately above the pump. The riser discharges into a 20-in. wire-wound wood pipe with wooden collars. The wood pipe is located just below ground level and is 1700 ft. in length. At a point 750 ft. from the pump plant a cast-iron Y is inserted and one branch line 50 ft. long leads to the present main canal and the other branch line continues up the hill for 900 ft. to a point 70 ft. above mean river level, where it is proposed at some future time to develop a tract of land subject to a canal at this elevation.

This plant had a satisfactory operation for the season of 1914 and in the fall of that year it was decided to install a second unit of the same size as the first, but as the new unit was to be of the horizontal type it was necessary to construct a new pit, which is located on the downstream side adjoining the old one, and the two are connected at the bottom by an archway. The new pit is 12 x 16 ft. in plan and 2¼ ft. deep with 12 in. at the top, increasing to 18 in. at the bottom. The 12-in. floor is of reinforced waterproofed concrete.

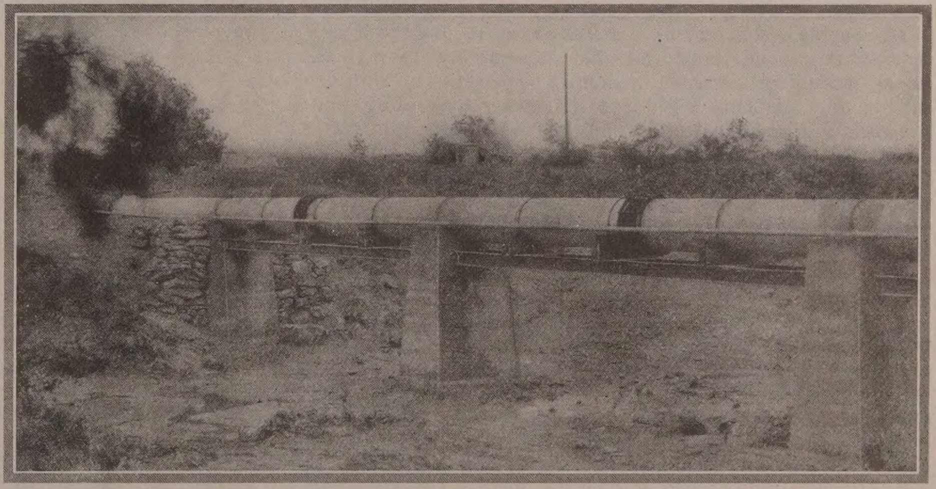
The conduit between the new unit and the canal head consists of 350 ft. of wood pipe similar to the first installation and 250 ft. of 20-in. galvanized spiral riveted steel pipe in 20-ft. lengths, having flexible bolted connections, the reason for using the steel pipe being that a small arroya had to be crossed which would necessarily expose the pipe. In addition, for the last 160 ft. the line was on a sharp rise to the canal head, which subjected the joints to angles, and it was feared that these conditions could not be taken care of by the wood pipe.

It was found necessary to install air chambers on each discharge line just outside of the pumphouse between the risers and the wood pipe. They consist of a piece of 14-in. pipe 16 ft. long and closed at the top end. Before the installation of these chambers, upon switching off the power, the units quickly came to a dead stop and the back lash in the pipe lines created such a shock that it always sprung the wood pipe, causing leakage, which it was feared might ultimately cause their failure. After the chambers were in place the back lash was seldom felt and when it was it was so slight that no damage was done. The air chambers are shown in the view of the pumphouse.

The priming of the pumps is done by Nash rotary vacuum pumps, one direct-connected to a 1½-hp. motor and the other belt-driven by a 2-hp. motor. The piping of each primer is so arranged that either pump can be primed by either primer. The primary power line consists of 18 miles of three-phase, 13,500-volt line of No. 4 medium hard drawn copper wire on 40-ft. poles spaced 275 ft. apart. By changing the insulation the line voltage can be increased to 22,000.

Farm Use for Electricity

Having got the pole line so close, it was extended for farm use by a 2300-volt line carrying current from the step-down station to the ranch buildings two miles distant, where it is used for lighting and for operating the water supply system. The water level in the elevated tank is controlled by a float control switch and the pumping unit is a centrifugal pump direct-connected to a 5-hp. motor. The forge blower, band saw and other small tools in the blacksmith and carpenter shops are also motor-driven.



PIPE LINE FROM TEXAS PUMPING PLANT CROSSING AN ARROYO

One of the unique and practical applications made of electricity on the ranch is the operation of the ensilage cutters. There have been constructed sixteen reinforced concrete silos 20 ft. in diameter by 60 ft. high, each having a capacity of 500 tons. They are located on the borders of the farm in groups of from two to four and a power line furnishes power to them all. The ensilage cutters are belt-driven by a 35-hp. 2300-volt induction motor. After two seasons of operation this arrangement has proved entirely satisfactory. The motor is mounted on a small housed-over truck so that it can be moved from silo to silo.

High Efficiencies Are Obtained

In April, 1915, the pumping units were tested and high efficiencies were obtained. The static head of the vertical unit is 55.34 ft. and the total head, including friction and pump losses, is 72.59 ft., making friction and pump losses of 17.25 ft. The water was measured by a 4-ft. Cippoletti weir placed in the canal several hundred feet below the canal head. Power input was measured by an integrating wattmeter. Head was measured by pressure and vacuum gages and a mercury U tube. An average of ½-hr. readings taken for 12 hr. gave 3636.5 gal. per minute discharge, a power input of 104.9 hp. with a calculated water horsepower of 66.6. Allowing 91.5 per cent motor efficiency and 90 per cent shaft-bearing efficiency, the horsepower input at the pump was 86.38, which gave a pump efficiency of 77 per cent.

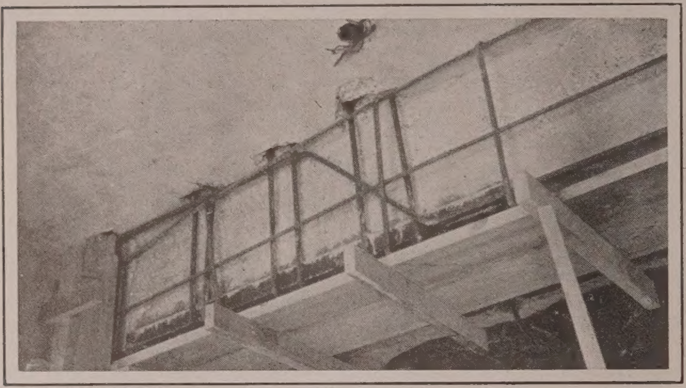
The static head of the horizontal unit is 55.01 ft. and the total head, including friction and pump losses, 70.63 ft., making friction and pump losses of 15.62 ft. The average discharge was 4726.4 gal. per minute and the power input was 103.64 hp. with a calculated water horsepower of 84.2, which gave a pump efficiency of 81.24 per cent. The machinery and equipment was furnished by A. M. Lockett & Company of Houston and New Orleans, with the exception of the wood pipe, which was furnished by the Pacific Coast Pipe Company, Seattle. All designs and plans were made and the construction supervised by B. G. Slining, consulting engineer, of San Antonio.

Three Reinforced-Concrete Buildings Alone Resist Flames in Paris, Texas, Fire

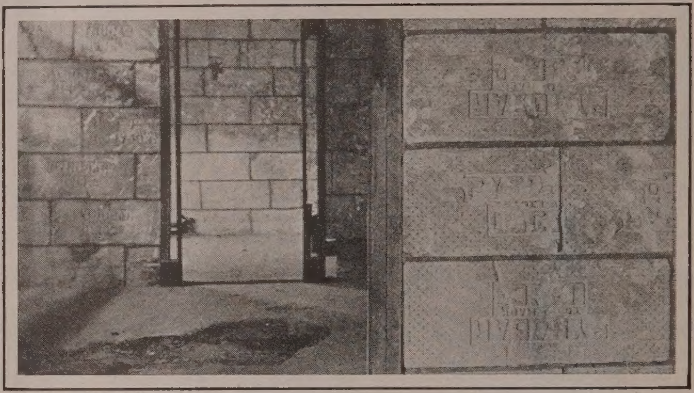
Methods of Repairing Beams and Tying-in Walls to Strengthen Injured Structure Outlined—Wire Glass Windows and Gypsum Partitions Withstand Test

CONVINCING evidence of the effectiveness of reinforced concrete as a fire-resistive construction is furnished by the fact that three reinforced-concrete buildings directly in the path of the Paris, Tex., fire were the only buildings that came through practically unharmed. As described in the Engineering Record of April 1, page 463, and illustrated in the issue of April 15, page 529, this fire was extremely destructive, ranking as the fourth of the great fires in this country. The total losses are estimated between $10,000,000 and $12,000,000, about $4,500,000 being covered by insurance.

The people of the city have already begun reconstruction on improved and modern lines, widening streets, planning open courts, and adopting rigid fire limits and fire-resistive construction. The lesson to be learned from the effects of the fire are here outlined, and a description is given of the methods used in repairing minor injuries to one of the reinforced-concrete structures.



REINFORCEMENT ADDED AND CONCRETE BEAM WIDENED



GYPSUM PARTITIONS WITHSTAND FIRE TEST

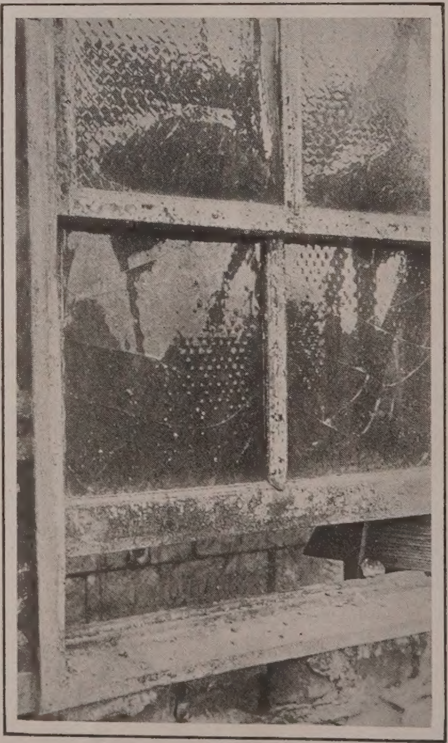
BUILDINGS LITTLE DAMAGED

There were three reinforced-concrete buildings in the direct path of the flames, and these are the only structures so located which now remain standing. The least damaged of these is the Wise apartment house. A livery barn at the rear and a residence on the south side of this building were completely destroyed, and on the north side a store building full of merchandise stood within 10 ft. of the apartment. The heat was so intense that the interior furnishings must have caught fire from radiation alone. All the windows on this side were of glass with steel frames, and every window was shut. Not a pane of glass came out, although the glass melted and flowed, bulging badly and cracking, as shown in one of the accompanying photographs. The upper half of the windows were of ribbed wire glass and the lower half of glazed wire glass. The ribbed glass bent much more than the glazed, and in one case actually flowed from the top and the pane curled over.

The building which ranks second in small amount of damage done by the fire is the Gibraltar Hotel. This structure also had other buildings burned on three sides of it. The two sides of the hotel were equipped with wire glass windows and steel sash, which excluded the fire. The rear of the building, however, was equipped with wooden sash and plain glass, and the fire soon found its way through these openings. Everything composed of wood or other combustible material was entirely destroyed, except on the ground floor and in a few of the front rooms.

GYPSUM BLOCKS STAND WELL

All partitions were constructed of gypsum block, and although in most cases the plastering was entirely removed from the walls, the blocks remained intact. An accompanying photograph shows the gypsum block walls with the plaster burned away. There is no sign of damage to any concrete in the building, and the steel-framed windows, although ruined, performed their function and can even now be raised and lowered. The elevators, inside fireproof walls and steel doors, remained in running order, and the refrigerating plant in good working condition. The estimated damage to the building was about 42 per cent.



WIRE GLASS WINDOWS STILL INTACT

The third building was the First National Bank. Buildings were destroyed completely on all four sides of this structure, and it is reported that these buildings were also dynamited in an attempt to check the fire. The west and north sides were equipped with wire glass and steel sash, and in every case the windows remained intact. The south and east sides had plain glass windows and, with a few exceptions on the fifth floor, these are entirely gone. With the exception of the fifth and ground floors there is nothing left in the building but the reinforced-concrete columns, beams and floors. The partitions were chiefly of wire lath, and these were completely destroyed.

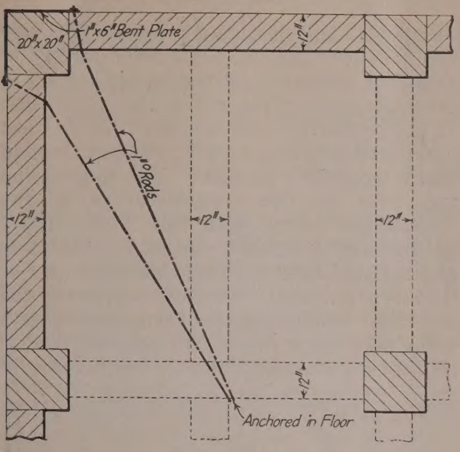
REPAIRING DAMAGED BEAMS

In some cases the reinforced concrete in this building was badly damaged, probably due to the effects of dynamiting the adjacent building. Several of the beams cracked badly, and the west wall separated from the rest of the building. In two cases the beams failed so badly that a continuous solid concrete wall was built under the failed sections. Practically every column is being strengthened by the addition of 3½ to 4 in. of concrete on each side.

The floor was constructed of T-beams and a 5-in. slab. For beams which are in very bad condition, 1 in. or more of the floor surface is removed and twelve holes are drilled. Small angles are placed on the lower corners of the beams and U-bolts are inserted and drawn up with plates and bolts. These are shown in an accompanying photograph, the U-bolts being spread at the top in order to get good bond between the new steel and new concrete. Reinforcing rods are placed as shown, and the forms built around the beams. New concrete is then poured through the holes made for the U-bolts and through additional holes made along the length of the beams. The depth of the beam is thus increased by 3½ to 4 in., and the width by 6 to 7 in.

ANCHORING THE WALLS

To tie the corners and intermediate columns of the building the following method is being used: Level with the floor surface the outside brick facing is removed and a 6 x 1-in. continuous bent steel plate is placed around the column, as shown in the accompanying drawing. The 1-in. rods are then anchored down through the floor at one end, passing along the top of the floor through the outside wall and tightened by nuts at the outside end. New concrete is then laid on the floor surface to cover the rods.



METHOD OF TYING THE CORNER COLUMN

The building is being salvaged by the firm of Lang & Witchell, architects, of Dallas, Tex., and a local firm of contractors, Finn Owings & Company, are doing the work.

UNPROTECTED STEEL FAILS

This fire also demonstrated the fact that unprotected steel is practically sure to fail in case of fire. The court house was of the old type of fireproof building, with stone exterior, steel I-beams and flat-arch tile floors, with steel roof trusses and book-tile and slate roof. The steel is simply a tangled mass, some of it practically tied into knots.

The people of Paris are taking advantage of their loss to properly plan the streets and parks and lay out a better city. All the main thoroughfares will be changed from 60 ft. to 80 ft. in width and all 40-ft. streets widened to 50 ft. About 4 miles of new streets will be added. The present city square will be parked and a new market square has been laid out. A permanent road leading from the present main road several miles northeast of the town will be constructed directly into the center of the city. A new city hall, court house, and school building will be constructed and the government has appropriated $200,000 for the erection of a new post office. Building districts are fixed for all types of buildings in every part of the city. The code of the State Fire Insurance Commission has been adopted and everything within the fire limits will be required to be of fire-resistive construction.

Transverse Brick Tests Proposed as a Measure of Pier Strength

That transverse tests of brick will give a fairly reliable measure of the strength of brick piers when laid up in mortar is announced as a result of the series of tests on large brick piers made by the U. S. Bureau of Standards (see Engineering Record of April 10, 1915, page 460) and an auxiliary series of tests of the bricks for transverse strength. In a paper on this subject presented at the thirtieth annual convention of the National Brick Manufacturers' Association by J. G. Bragg, assistant physicist, results of these tests were given.

In conclusion it was stated that considering the results of this investigation, while additional data is needed to justify the assertion that a ratio based on the transverse tests of bricks could be established which would be of assistance in estimating the strength of brick masonry, this method is much more efficient and more satisfactory than the usual crushing test of the brick.

Storage Reservoir Feeders Planned to Abate Naugatuck River Nuisance

Co-operation among 25 New England Manufacturers Leads to Comprehensive Project for Water Conservation—Three Dams Proposed

By CHARLES H. PRESTON, JR.
Consulting Engineer, Waterbury, Conn.

SHORTAGE of water for industrial purposes, accompanied by insanitary conditions resulting from decomposing sewage deposits during dry months, led twenty-five corporations with manufacturing plants along the Naugatuck River in Connecticut to co-operate in a project for equalizing the stream flow by means of a series of three dams in the upper Naugatuck drainage basin, designed to impound 13,000,000,000 gal. of water at a cost of several million dollars. The first of the three dams to be built will be of cyclopean masonry, 142 ft. high and 1300 ft. long on top, and will contain 800,000 cu. yd. of masonry. The manufacturers, cities and villages will petition the General Assembly in January, 1917, for charter rights to begin the first development.

LEAD MINE BROOK AT SITE OF DAM NO. 2

STREAM FLOW VARIES

The Naugatuck River, flowing through a narrow valley of the western section of Connecticut with precipitous hills on either side, and numerous dams and mill ponds that cause a fluctuating stream flow, is, length considered, the most important stream in New England from an industrial point of view. The extremes in run-off, together with control of water by the many dams across the river, result in the river bed being dry in numerous places during the months of June, July, August and September of each year. Towns, villages and cities along its course empty their sewage, untreated, into it together with manufacturing wastes of many descriptions, causing the river to become badly polluted, a condition probably the most insanitary in the State. The river banks during these dry months are coated with heavy layers of decomposing sludge and other deposits, visible at low water, particularly south of Waterbury to its confluence with the Housatonic River at Derby.

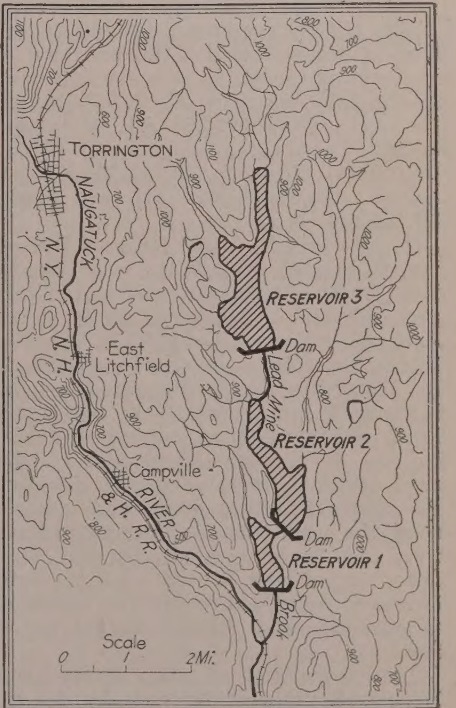
From its sources, Hart Brook, Hall Meadow Brook, the East Branch and Lead Mine Brook in the towns of Norfolk, Goshen, Winchester and Torrington, all of which are in Litchfield County, to its confluence, the river is 44 miles in length and its watershed, varying in width from 5 to 10 miles, has a total area of 326 sq. miles. Its daily discharge at Waterbury varies from 125 to 5500 sec-ft., and this extreme change will occur in 5 hours.

The estimated population of the watershed is 150,000, comprising a total of 25 cities, towns and villages, the most important of which are Torrington, Thomaston, Waterbury, Naugatuck, Seymour, Ansonia and Derby. Statistics of manufacture include metal, rubber, galvanizing, silk, textile and dye works, laundries, paper mills, grist mills and breweries, a total of 130, of which 95 are brass or other metal works.

The grade from the town of Winchester to Derby is 1300 ft. and the average precipitation during the past 29 years has been 48.88 in., by months as follows: January, 4.25 in.; February, 4.14 in.; March, 4.49 in.; April, 3.74 in.; May, 3.82 in.; June, 3.32 in.; July, 4.65 in.; August, 4.48 in.; September, 3.77 in.; October, 4.10 in.; November, 3.64 in.; December, 4.33 in.

MANUFACTURERS JOIN FORCES

Shortage of water for industrial purposes, together with extreme insanitary conditions along the river, was the direct cause of a movement, taken up by the twenty-five corporations whose sites adjoin the river banks, to investigate a method of relief. On April 13, 1914, manufacturers of the Naugatuck Valley, in general meeting called for the purpose of discussing proposed water conservation in the upper Naugatuck drainage



LOCATION OF THREE PROPOSED IMPOUNDING RESERVOIRS ON LEAD MINE BROOK basin, voted an appropriation of several thousand dollars for an engineering investigation and report on the proposed project. Lead Mine Brook, in the town of Harwinton, was selected for the proposed first development.

The total area of Lead Mine Brook watershed is 24 sq. miles. It has a length of 9 miles and varies in width from 2½ to 5 miles. Records taken at the stream since September, 1914, to date show the following monthly yield:

Total yield in million gallons varying from 7.2 to 6347.6.

Average yield per square mile, million gallons per day, varying from 0.0110 to 9.3200.

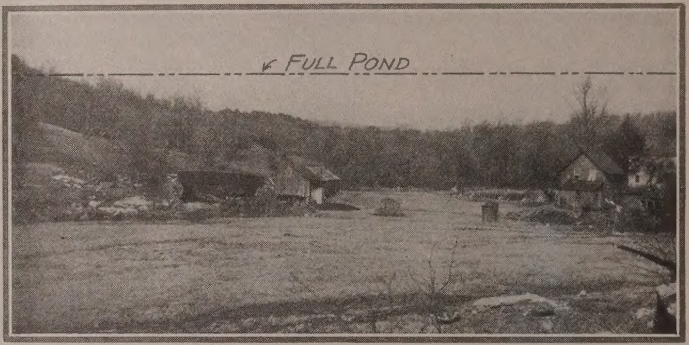
Average yield per square mile, second-feet, from 0.017 to 14.421.

Rainfall in inches from 0.12 to 7.13.

Rainfall collected, 0.02 to 8.17 in.

Percentage of rainfall collected, from 2.4 to 341.7.

The width of the Naugatuck River varies from 67 to 325 ft., but the average of 25 different points between Torrington and Derby is 125.5 ft. Of the 326 sq. miles of watershed included within the Naugatuck River drainage basin, Torrington has a run-off of 54 sq. miles, Thomaston 128 sq. miles, Waterbury 210 sq. miles, Naugatuck 254 sq. miles, Seymour 307 sq. miles, Ansonia 323 sq. miles, and Derby the total of 326 sq. miles.



WHEN POVERTY HOLLOW IS FLOODED BY RESERVOIR NO. 2 THE COUNTRY WILL BE UNDER 90 FEET OF WATER

NAUGATUCK RIVER BED EXPOSED AT SEYMOUR, WHERE DRAINAGE AREA IS 307 SQUARE MILES

Rainfall and Run-off

With the average annual precipitation of 48.88 in. and six-tenths of this precipitation representing run-off, there is annually passing through Torrington 27,694,558,000 gal., Thomaston 65,861,377,000 gal., Waterbury 107,382,791,000 gal., Naugatuck 129,808,031,000 gal., Seymour 157,211,552,000 gal., Ansonia 164,998,094,000 gal. and Derby 166,591,144,000 gal.

If fully conserved, this Naugatuck River run-off, passing through the river channel daily for an entire year, would produce a stream flow at the different points as follows, each on the basis of 125.5 ft. in width: Torrington, 5 in. in depth; Thomaston, 12 in.; Waterbury, 20 in.; Naugatuck, 24 in.; Seymour, 29 in.; Ansonia, 30 in., and Derby, 31 in. With the low rate of run-off during the four dry months of each year and the huge volume of untreated sewage, chemicals and other impurities discharged into the river, the conditions are extremely insanitary, and the proposed development, from this point of view, as well as the greatly increased water power for the numerous corporations, is a matter of vital importance.

The conservation of water in the upper Naugatuck drainage basin is by far the most practicable method of equalizing the stream flow of the river, and the improvement to the cities and towns along its banks, particularly below Waterbury, would make the project a worthy one, if from no other than a sanitary point of view. The development of Lead Mine Brook in total would create a stream 12 in. in depth and the average width for the four dry months of each year, and with further developments on tributary streams north of Lead Mine Brook a full, dependable stream flow sufficient to flush the river to a sanitary condition throughout the four months could be secured.

Manufacturers, as individuals and corporations, have long pondered this idea and municipalities have craved the adoption of this or any other plan that would give them relief, if no more than temporary, from unsolved sewage disposal problems and from stenches as unhealthy as they are repulsive. At present the river is an open sewer. To such an extent is it used for sewage disposal purposes that for 100,000 people living along the banks south of Waterbury it is an annual midsummer nuisance and menace. If it were not for the copious discharge of mill acids and chemicals, some of which help to counteract the noxious sewage, conditions would no doubt be even worse than they are, if such could be possible.

In midwinter severe weather covers up and freezes down, and in the spring the heavy rains and thawing snow flush and cleanse; but in midsummer the water dwindles by waste and evaporation and the current is by far too small either to carry off accumulations or adequately serve industrial purposes.

Three Dams Proposed

It is proposed to build a series of three dams of cyclopean masonry to be designated as Nos. 1, 2 and 3. The first of the three to be developed will be No. 2, which is of gravity type, having a length on top of 1300 ft. and a maximum height above top of foundation of 142 ft., 13 ft. thick at top and 118 ft. thick at the base. This dam will create a pond covering 316 acres and will impound 3,413,000,000 gal., will contain 800,000 cu. yd. of masonry and will cost $1,000,000. With the others, Nos. 1 and 3, developed, it is planned to impound about 13,000,000,000 gal. of water. The total cost will be several million dollars.

The manufacturers, cities, villages and towns will petition the General Assembly in January, 1917, for charter rights to begin the first development, No. 2 reservoir, which will take rank among the notable dams of New England on account of its dimensions. It is designed on conservative lines to meet extreme conditions of precipitation, run-off and temperature changes. The commission appointed by the manufacturers of the Naugatuck Valley, with full charge of all preliminary investigations and reports, is ex-Senator Lewis A. Platt, chairman, of Waterbury; W. H. H. Wooster, secretary; the Seymour Manufacturing Company of Seymour, and the writer. The project, including plans and specifications, has been fully approved by the State Board of Civil Engineers, which has issued a certificate of approval.

Patrol Maintenance Saves Gravel Roads Under Heavy Traffic

The gravel or dirt-and-gravel roads of New Hampshire are maintained under severe motor-vehicle traffic by local patrolmen under the direction of the State Highway Department. As stated by the *Highway Magazine*, the success of this method is due to two essentials: Honest, efficient and decently paid patrolmen, and a willingness of the department to spend $200 or $300 per mile per year, or even more in exceptional cases, on plain gravel-road maintenance. The patrolmen are not ordinary laborers, but intelligent natives.

Each man is required to provide himself with a horse, dump cart, chain, shovel, pick, iron bar, hoe, rake, axe and brush hook, and is expected to spend his whole working day of nine hours, six days a week, on the job during the working season at a daily wage of $3 to $3.50. In brief, the patrolman's duties are to patrol his section frequently and to see that the road is clear of stones, broken glass or anything of a foreign nature; to see that the ditches and shoulders are cleaned, the culverts clear and bushes cut, and to pay particular attention to the cleaning of the culverts and ditches after a rain. He is to patch any ruts and holes that may appear and drag the road after every rainstorm or shower or whenever the road surface is damp. He is also required to report to the division engineer any dangerous place or conditions on the roads or bridges within the towns of his section. These are not actually under his supervision, however. It is also planned that hereafter one experienced man will give his whole time as inspector for the patrolmen. Ordinarily from $1,000 to $1,200 a year are available for each patrol section for wages and material. By good judgment on the part of the patrolman and the division engineer, this system works out admirably and makes the patrolman's job one of a high grade of intelligence and workmanship.

National Defense—For Engineer and Contractor

Ninth and Final Article in Series Describing How Engineers and Contractors Can Increase Their Military Efficiency in Time of Peace

By Major P. S. BOND
Corps of Engineers, U. S. Army

WE have now considered our present military policy and have seen how this policy precludes that thorough preparation for war which is possible only by means of large standing armies and trained reserves. It will be apparent to the reader that the national defense relies at present chiefly upon the patriotic willingness of our citizens to prepare themselves partially during peace for volunteer duty in war. We have briefly reviewed some of the principal operations of military field engineering and have indicated the essential differences between military and civil practice.

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THE PROBLEM OF FIELD TRAINING FOR PRACTISING ENGINEERS MIGHT BE ACCOMPLISHED BY AN APPLICATION OF THE BUSINESS MEN'S CAMP EXPERIMENT TRIED AT PLATTSBURG LAST SUMMER

In what respects are our civil engineers and contractors qualified to meet the military obligations of citizenship, and what may they do under present conditions to increase their efficiency? There is no class of our citizens more intelligent or more patriotic than the engineering profession. But patriotism which finds its sole expression in tear-dimmed eyes and choked throats is of no practical value to the national defense. The highest form of patriotism—the only useful form—is that which recognizes the obligation of citizenship and voluntarily prepares to meet it.

CONTRACTORS VALUABLE MATERIAL

The engineer officer, as we have seen, must be both a soldier and an engineer. If it be necessary for the volunteer candidate to acquire both these qualifications, a considerable period will be required for his proper training and he will not be ready to take the field at the same time as the volunteers of other arms. Our civil engineers and contractors, possessing in advance the technical training in construction, constitute the best material for the supply of engineer officers. Contractors may be of very great help. The hustling American contractor possesses most of the qualifications so necessary in the successful military engineer. He is often in these days a man with technical training, he is always used to outdoor work, he knows how to handle men and is familiar with construction plant, he has initiative and resource—otherwise he would seek a different profession—and he appreciates the importance of speed in construction work. The eye of the military appraiser turns appreciatively upon the contractor, who possesses so many of the qualifications he seeks.

Contractors' foremen, being used to handling men and outdoor construction, will constitute excellent material for non-commissioned officers of engineers—the pioneers of the mobile army. For the rank and file of the volunteer engineer battalion we may find ample material in our great industrial organization. Of all these candidates there is none more valuable than the man who has had experience as a laborer on general contract work. He is usually handy, used to outdoor work and exposure and, to a considerable degree, is disciplined in a military sense. The contractor, his foreman and his gang are of great value as a military asset. Men with some outdoor experience will ordinarily be preferable to those whose careers have been limited to the office.

TRAIN IN TIME OF PEACE

But, however thorough his technical training, however extensive his experience, and however great his natural adaptability and resource, the civilian engineer has very much to learn before he will be qualified to perform his military duties. He must learn his duties as a soldier, acquire a practical knowledge of tactics, and adapt his civil engineering knowledge to military requirements. In most instances he must divest himself of certain preconceived ideas and methods. In view of the very short time that will be allowed for intensive training after the outbreak of war before the volunteer army will be called upon to take its place in the line of battle, it is absolutely essential that some portion of this necessary training be obtained in time of peace, especially in the case of engineers. How may this be accomplished? Assuming the patriotic willingness of the engineering profession to meet the obligations of citizenship, how may they be afforded the opportunity to acquire training?

The first step manifestly is to interest the profession in this important matter of national defense. They must be brought to a realization of what our military policy is, the extent of its reliance upon voluntary service, and how important is the part of the engineer in any scheme of defense that is likely to be adopted by the American people. It is not only necessary to arouse this interest on the part of the profession, but to maintain it, which is equally important and far more difficult. With a great war now going on in Europe there is little difficulty in interesting the people of this country in military affairs. But experience shows that our martial ardor cools very rapidly as the scenes of actual warfare recede into the past.

SUBSIDIZE INSTRUCTION

It will be necessary to devise some system by which those men who are willing to undergo training can be instructed in the duties of military engineering. It is too much to expect of the average civilian engineer that he would pursue a lonely course of study on a subject outside of his regular practice, one, moreover, which holds out no promise of financial return. The driving force or incentive to the pursuit of such study would be lacking, and the men would be glad to have some form of compulsion or obligation applied. Moreover, such study would produce little result except under the guidance of professional engineer officers. Moreover, the study should be supplemented by practical training in the field. To produce results, then, it is apparent that this instruction must be subsidized and directed by the War Department. The engineering societies might advantageously act as intermediaries between the government and the individuals, chiefly in the important matter of attendance, though it is not intended to suggest that the instruction be limited to members of such societies.

Several schemes for such instruction suggest themselves. A number of colleges and universities have at present courses of military instruction, and it is possible that the number will be increased in the not distant future. At engineering colleges this military instruction might readily be extended to include a course in practical military engineering, with class-room work, lectures and field instruction. The course would cover the more important duties that have been heretofore outlined. This course would be similar to that now pursued at the U. S. Military Academy, the federal government co-operating with the institution in furnishing instructors and equipment. Such a course would have considerable military value and would certainly be useful also from a purely civil point of view. It could be readily inaugurated and the expense would be inconsiderable in comparison with the benefits. Schools having such departments could afford some of the tactical and technical training which the profession of military engineering demands.

THE PLATTSBURG CAMP IDEA

The problem of reaching effectively the graduates or practising engineers is more difficult. It might be accomplished by an application of the "business men's camp" experiment, such as was conducted recently at Plattsburg, N. Y., and at other places. The greatest difficulty in the way of success is that of attendance. This, of course, must be entirely voluntary, and is in the hands of the engineers themselves and of their employers. It is probable that many patriotic employers, if they could be made to realize the great need for and importance of such training, would pledge themselves to grant leave with pay to engineers desiring to attend the instruction. It is unfortunately true that under our present military policy we must appeal to and rely largely for success on the patriotic spirit of individual citizens. The burden is thus unequally distributed and must always be unless compulsory service is adopted. The federal, state and municipal governments, which employ large numbers of civilian engineers, might well set a good example in this way by making it possible for their technical employees to attend such instruction camps. If systematic attendance can be secured all other difficulties in the way of reasonable measure of success may be overcome.

To obtain the best results congressional action would probably be necessary. There would be many details to work out, but the scheme holds some promise of success and is at least worth an experiment. The writer is aware that from the point of view of efficiency the scheme has disadvantages in common with all other schemes based on voluntary service. But we must face conditions as we find them and do the best we can under the difficulties that exist. Rational preparedness for defense is necessary for the maintenance of peace and dignity—indeed, for the assurance of our continued national existence. As our former Secretary of War has pointed out, if we wish to avoid compulsory service on the one hand and almost utter defenselessness on the other, our citizens must prove that a voluntary system based on patriotism can be relied upon to insure adequate defense, even if it does not provide the best possible defense.

Field training in military engineering has been developed to a high degree of practical efficiency in the regular army and, under the supervision of officers of the Corps of Engineers, can be readily adapted to the instruction of civilians. The government owns or may obtain the use of tracts of land suitable for the instruction camps in the vicinity of many large cities, such as New York, Chicago, San Francisco, St. Paul, Minneapolis, Kansas City, Washington, etc. The engineers resident in such cities could thus reach the camp at a small expense in time and money. Each camp would be in charge of several regular engineer officers with a detachment of engineer troops and the necessary equipment in the way of instruments, tools and materials.

FIELD INSTRUCTION

The course of instruction should be prepared in advance, and should be varied and progressive to stimulate interest while carefully avoiding unnecessary fatigue. As in the school training, previously referred to, it should be along both tactical and technical lines. The details of camp life and the operations of field engineering are essentially interesting and the course of instruction, if intelligently carried out, would leave with the students the impression of having enjoyed a profitable and pleasant vacation, and this would go far toward insuring their attendance at subsequent sessions. More advanced courses would be prepared for men in attendance at their second or third encampment.

The instruction should properly be extended over several encampments. It would include camping methods, camp administration and sanitation, simple infantry drill and the manual of arms, marches, security measures in camp and on the march, battle exercises, target practice, and instruction in practical military engineering along the lines heretofore discussed. The instruction would include examinations and discussions of previously constructed works, demonstrations by the regular detachment, the actual construction of simple bridges, sections of road, trenches, obstacles, etc., the use of the ponton equipage, demolition and sketching by the students themselves, the solution of simple tactical problems, including, in particular, the selection and organization of a defensive position, the writing of orders, lectures, critiques and discussions.

A very simple course of instruction along these general lines would require several successive encampments. Such a course would not make expert military engineers of the students, but it would afford them a practical conception of military methods, show them how much there is to be learned, and stimulate their interest in military affairs. They would undoubtedly become more valuable as a military asset than perfectly green men having no conception of the nature of military operations.

This field training could advantageously be supplemented by a correspondence course of practical problems in military tactics, map reading, and military engineering, accompanied by a course of reading. Reading alone would be of little value, inasmuch as we obtain no mental training when another does our thinking for us, and even the knowledge acquired is quickly forgotten. It is experience and responsibility that develop judgment, initiative and the power of decision. When a student reads a text book on the art of war the responsibility for the facts alleged and the deductions made rests entirely upon the author. From such works the student temporarily acquires a certain amount of information, but he certainly assumes no mental responsibility and without this he receives no training. When, however, he undertakes the independent solution of a practical problem, whether in the field or at his desk, the responsibility rests upon his shoulders alone and the results he obtains are impressed upon his mind as practical experience. These principles should form the basis of the instruction in the field work and correspondence courses. Reading is indeed of value, but has its greatest value in connection with original and independent effort on the part of the student.

SOLUTION OF PRACTICAL PROBLEMS

The solution of these practical military problems, whether on a map or in the field, constitutes what is known as the applicatory method of military instruction. It is the method which is pursued by all modern armies, being properly regarded as the best substitute possible in time of peace for the actual experiences of war. Without doubt this study is one of the most stimulating and entertaining of mental activities.

The problem as stated sets forth the situation of or circumstances surrounding a certain imaginary body of troops of which the student is assumed to be the supreme or one of the subordinate commanders. The statement covers the position and strength of the friendly troops, the local conditions as to terrain, weather, etc., certain information concerning the enemy, usually more or less incomplete and inexact, the orders and instructions of higher authority, etc. From a careful consideration of all this information the commander shapes his course of action. He first determines his mission or purpose. Often this will be embodied in the orders he has received, but circumstances may arise which compel him to disregard orders which did not contemplate these circumstances. His mission must then be deduced from his knowledge of the situation as a whole and of the wishes or intention of his superior. It may demand a course of action at variance with the orders he has received and it is here that his judgment is called into play.

Having determined his mission, the commander reviews the various courses open to him and comes to a decision on the course which appears to offer the greatest promise of success. This decision will require a rapid, but thorough consideration of all the possibilities of the situation. He next prepares the details of a plan for carrying out his decision and finally embodies this plan in orders to his subordinates. The review or estimate of the situation, the deduction of the true mission, the arrival at a decision, and the preparation of the plan and orders constitute the solution of the problem. These interesting and instructive mental processes will be no innovation in the brain of any thinking man, inasmuch as they are characteristic, not only of military problems, but of all the serious affairs of life.

Examination for Commissions

Individuals who had received training of this nature in college, or who had attended a certain stipulated number of instruction periods in camp, or both, should be given an opportunity to qualify by suitable examination for a commission in the volunteer engineers. Such a commission might properly carry with it a small allowance to be paid by the federal government. The possibility of obtaining such a commission would have a stimulating effect, especially among the younger men, since, even without a money allowance, it would constitute an honorable distinction. The man who, while pursuing a civil calling, still recognizes the obligations of his citizenship and endeavors, even to a small degree, to fit himself for the discharge of those obligations, is and should be recognized as the best type of practical patriot. Such men are the real patriots on whom alone we can rely with any degree of confidence for the maintenance of the national defense. The writer believes that there are many such men among our engineers and contractors and that the nation would do well to afford them the necessary training, which they are ready to receive.

4.—FIFTY-FOOT HOLES DRILLED FOR GROUTING AS A MEANS OF REPAIRING BRIDGE

The educational schemes which have been outlined are to be regarded as tentative only. Their details have not been worked out and they are undoubtedly incomplete and perhaps faulty in many respects. The writer does not urge them as a policy to be adopted. Such a policy must be based on careful study by our governmental and military authorities, assisted by the civil profession. But whatever policy may be adopted for the mobilization of our resources in engineering personnel it will depend for its success on the interest and voluntary co-operation of the civil engineers of America. If, actuated by a spirit of practical patriotism, our engineers desire to prepare themselves to meet the obligations of citizenship in the defense of their country, means can be found to give them a portion of the training of which they are in need.

[*The End.*]

Rock Drilling with Deep Hole Wagon Rigs Shows Speed at Low Cost

Mobility of Outfits and Ability to Sink Three Holes from One Set-Up Make for Economy on Heavy Excavation

By CHARLES A. HIRSCHBERG
Of the Ingersoll-Rand Company, New York

SUFFICIENT time has elapsed since the introduction of the first deep-hole drilling rig about five years ago to determine definitely the fitness of such apparatus for use in rock excavation. An analysis of the uses to which it has been successfully put, and the results accomplished, demonstrate conclusively that such work as the excavation of rock in deep crushed-rock quarries, extensive railroad cuts and canal work is the especial field of the deep-hole drilling rig.

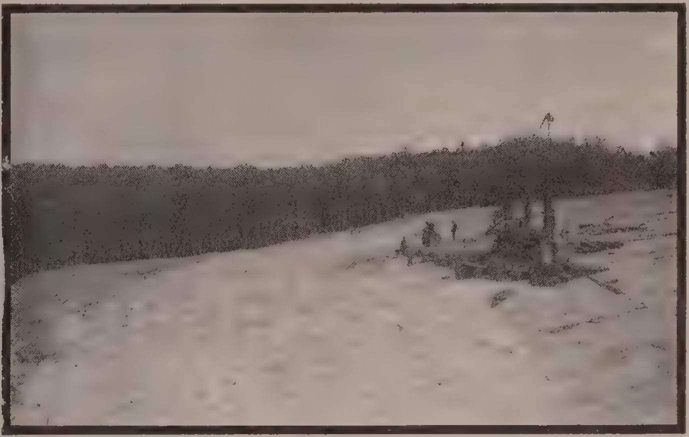
The main problem presented by such work—the rapid breaking up of large areas of rock—is such that the ordinary type of drilling machine mounted on a tripod will not do, for, if the latter is light enough to permit of easy and quick mobility, it is not powerful enough to drill the depth and diameter of holes necessary to rapid and economical excavation in this class of work. If, on the other hand, heavy enough tripod drills are employed, they lack quick mobility and the time consumed and difficulties encountered in this respect make the operation of resetting for each hole slow and expensive.

The deep-hole rig, with its means for traction and ability to drill a number of holes at one setting, at once permits the employment of powerful drilling machines and eliminates a large portion of the dead time of resetting.

An idea of the economy which obtains, in labor alone, with these drilling rigs may be had when it is understood that they will drill from 150 to 250 ft. of large diameter hole per day with a crew of three men. With the tripod method the footage rarely exceeds 70 ft., and is more often as low as 60 ft. It would, therefore, require from three to four tripod drills to accomplish as much work, or from three to four times the labor and, of course, a proportionately greater amount of power.

Large diameter holes permit heavy powder loading, making springing unnecessary. This again means a material saving, as the springing of holes requires extra powder, extra labor, and in a great many cases results in the partial loss of holes, due to their becoming filled with muck in the springing process.

The progression of drilling with a deep-hole rig is shown in Fig. 1. The drill frame is swung at right angles to the line of progress, the jack-screw set, and a hole drilled. The drill is then raised and swung parallel with the line of progress and another hole drilled. Again the drill is raised and swung at right angles, to the opposite side, and a third hole drilled.



3.—SERIES OF HOLES DRILLED AND PREPARED FOR BLASTING IN KENSICO QUARRY, CATSKILL AQUEDUCT

In this manner three holes are put down from each position of the machine, two on a line at right angles, the distance apart depending upon the sweep of the drill frame, and one-half this distance in advance of or behind the others, and on a line midway between them. The drill wagon is then moved forward or back the proper distance and the operations repeated. When the required length has been covered, the drill is moved over and another triple row of holes, paralleling the first, put down, and so on continuously. Blasting is generally begun after sufficient ground has been drilled, while drilling progresses further on.

For successful drilling of deep holes it is necessary to provide a means for freeing the hole of cuttings during drilling operations. For this purpose a water jet is provided which is placed in the hole alongside the drill steel. A pipe about ½ in. in diameter is suspended from the top of the derrick, which can be raised or lowered to suit the position of the drill bit. This pipe is connected by means of rubber hose with either a pump mounted on the top of the drill wagon turntable, the pump suction being connected to any convenient water supply, or to a water pressure line. The amount of water fed into the hole is under the control of the operator.

In operating, the drill runner stands on the turntable, where he has control over

TABLE 1—PROGRESS WITH 15-FOOT FEED WAGON DRILLS ON CALUMET SAG CHANNEL OF CHICAGO DRAINAGE CANAL

	No. of 10-hour shifts	No. of Holes	Total Lineal Feet	Av. per shift
July, 1912	9	173	1,453	161
August, 1912	31	563	4,947	160
September, 1912....	50	1,051	8,512	170
October, 1912......	54	1,052	8,968	166
November, 1912....	49	537	6,197	126
December, 1912. ..	45	442	6,184	137
January, 1913......	47	750	6,809	145
February, 1913....	35	699	5,783	165
March, 1913 (2d lift)	38	643	4,909	129
April, 1913	52	796	10,464	201
May, 1913..........	54	897	10,820	200
June, 1913..........	54.9	1,016	13,287	244
July, 1913..........	50	838	10,679	213
August, 1913......	49.6	980	11,179	225
September, 1913...	52	984	12,170	234
October, 1913......	58.4	1,177	14,293	245
November, 1913....	50	739	10,679	214
December, 1913....	46.8	635	9,058	193
January, 1914......	36.9	533	7,304	200
February, 1914....	..	..	.....	...
March, 1914.......	16	219	2,974	185
April, 1914.........	50.5	910	11,629	230
May, 1914..........	52	1,040	12,434	239
June, 1914.........	50.4	973	11,245	223
July, 1914..........	54.8	1,044	12,411	226
August, 1914......	84	1,445	18,219	217
September, 1914....	37	676	7,117	192
November, 1914....	..	...	......	...
December, 1914....	12	12	2,565	211
March, 1915.......	12.6	173	2,422	192
April, 1915........	20.7	343	4,768	230

Average feet per drill per 10-hour day for entire 2½ years = 199.1.

the operation of the drill. The helper tends to the water jet and steel, lowering the pipe with the steel. As soon as a hole is finished a wooden plug is dropped into it, to keep it clear until ready for loading.

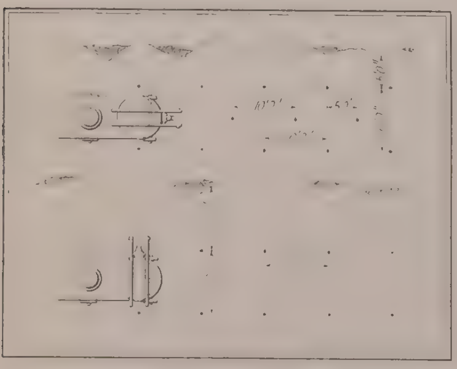
TYPICAL INSTALLATIONS

A few typical installations and records of accomplishment are described in the following.

Picture 2 shows one of sixteen deep hole drill wagons used on the Champlain Barge Canal, working ahead of a Marion steam shovel. The holes drilled averaged 12 ft. in depth and 4 in. in diameter. They were spaced on 5 and 10-ft. centers. Each hole was drilled with one length of steel. The average drill hole footage, per shift, for each drilling rig was between 160 and 200 ft.

On the Calumet Sag Channel of the Chicago Drainage Canal the contractors employed two 15-ft. feed steam wagon drills. The rock encountered in this work was hard Lemont limestone with flint strata. The excavation was made in three lifts, holes averaging 11 ft. 9 in. in depth and 3¼ in. in diameter. Two-inch hexagonal steel with cross-bits was used. The first lift was very much broken; the second and third lifts were solid. Table 1 shows the drilling progress made by the contractors under these conditions.

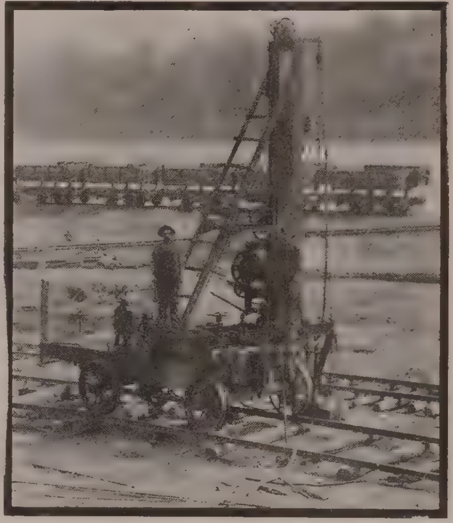
Another contractor secured the following results with two 20-ft. feed, steam wagon drills. The rock on this contract was hard Lemont limestone with flinty strata and containing horizontal seams filled with a cementaceous mud. In many places the rock was very shattered. The holes averaged 17 ft. in depth and 3½ in. in diameter. Two-inch hexagonal steel with cross-bits was used.



1.—PROGRESSION OF DRILLING WITH A DEEP-HOLE RIG, SHOWING HOW THREE HOLES ARE PUT DOWN FROM ONE SET-UP

The wagon drill employed in the quarry at Valhalla, N. Y., of H. S. Kerbaugh, Inc., contractors for the Kensico dam of the Catskill Aqueduct, was of the electric-air type, taking current from wires strung in the quarry. The holes drilled averaged 50 ft. in depth, bottoming 3 in. in diameter, and 30 ft., bottoming 4½ in. in diameter. Under test conditions 104 ft. of hole was drilled per shift.

It has been estimated that the cost per foot, based upon power and labor charges alone, on an average day's work of 50 ft. of hole (which was very conservative) approximated 14 cents per foot. The extraordinary feature, however, was the power cost. This sometimes ran as low as 30 cents per day and never exceeded 70 cents. Picture 3 shows a series of holes drilled and prepared for blasting in the Kensico quarry. It is surprising to note that the work was done by this type of rig on ground with a decided grade and irregular in contour.



2.—ONE OF SIXTEEN WAGON DRILLS ON CHAMPLAIN BARGE CANAL

Contractors on the United States Government Locks at Sault Ste Marie, Mich., employed four 18-ft. steam wagon drills. The rock drilled was Potsdam sandstone, considerably broken and containing many mud seams. Holes varied in depth from 18 to 27 ft. All holes bottomed 4¼ to 4½ in. in diameter. Cuttings would not mix satisfactorily with water and they were therefore drilled dry and a ⅜-in. jet of air at 100 lb. pressure was used to clean the holes.

Prior to the installation of these four wagon drills, fifty tripod drills were used, but could not keep ahead of the steam shovels. The four wagon drills which displaced them were 1000 ft. ahead of the shovels within three months after installation.

Table 3 gives the record of each traction drill working three shifts during July, 1913. Each drill ran three eight-hour shifts except where indicated.

A drill wagon was put to a rather novel use by Smith & McCormick, contractors, several years ago in repairing a heavy concrete bridge or arch over a tunnel of the Erie Railroad at Bergen Hill, N. J. Holes were drilled varying in depth from not less than 40 to more than 50 ft. in the concrete structure, which was of heterogeneous nature, comprising rough stones, more or less iron and other rubbish compacted with occasional loose or unfilled spaces, and, as a result, presented considerable drilling difficulties.

TABLE 2—PROGRESS WITH 20-FOOT FEED WAGON DRILLS

July 11 to Dec., 1914, and Feb. 22 to Aug. 8, 1915.

1914	Total lin. feet	Av. per shift	Max. shift	Min. shift
Drill No. 1—130 day shifts (10 hr.)......	27,739	213.4	425 ft.	68 ft.
Drill No. 1—49 night shifts (10 hr.)......	7,347	149.9	264 ft.	17 ft.
Drill No. 2—112 day shifts (10 hr.)......	28,174	251.5	425 ft.	85 ft.
Drill No. 2—30 night shifts (10 hr.)......	4,129	137.6	272 ft.	34 ft.
1915				
Drill No. 1—142 day shifts (10 hr.)......	37,658	265.1	475 ft.	64 ft.
Drill No. 2—139 day shifts (10 hr.)......	38,335	275.8	510 ft.	51 ft.

The purpose of the holes was to permit of pouring cement grouting to solidify the concrete mass, which had developed numerous cracks after completion. Picture 4 shows the rig at work as well as one of the 50-ft. steels employed for drilling.

FIVE CHURN DRILLS SUPERSEDED

During last year the Dewey Portland Cement Company of Dewey, Okla., installed a steam wagon drill for work in its cement quarry. Up to that time this drilling had been done with five churn drills, which were displaced.

The first row of holes was drilled within 10 ft. of the quarry face, this distance being sometimes increased to 15 ft. A second row of holes was drilled 10 ft. back of the first row. Holes were spaced 10 ft. apart in the rows. All holes were drilled with a single steel to a depth of 20 ft., bottoming 3½ in. An average drilling progress of ten and sometimes eleven holes per day obtained. In blasting, from thirty to fifty holes were exploded at one time.

The drilling crew consisted of three men receiving the following wages: Main operator $3 and two helpers $2 each per ten-hour day. No accurate record was kept of the coal consumption, but this was estimated to be 1300 lb. per day, costing $3 per ton delivered. Based on the foregoing costs and including the items of maintenance and depreciation, the cost per foot of hole drilled was 7½ cents per foot. This cost compares with 25 cents per foot for the churn drills formerly used.

It was further found that, owing to the ability to place the holes better, blockholing was reduced about 50 per cent.

TABLE 3—ROCK DRILLING AT SAULT STE. MARIE

Date	No. 1	No. 2	No. 3	No. 4
1................	194	136	120	272
2................	254	85	200	306
3................	194	170	200	234
7................	207	100	126	252
8................	253	176	136	270
9................	209	256	187	288
10................	240	†68	143	198
11................	*144	*153	*85	108
12................	†25	..	156	..
14................	150	194	270	*119
15................	100	216	154	234
16................	†25	180	126	171
17................	*125	216	221	304
18................	*100	306	264	313
19................	*125	270	*119	213
21................	*85	198	187	304
22................	*156	*108	*95	144
23................	153	162	160	272
24................	*136	180	172	240
25................	121	198	†36	240
26................	*106	*119	198	352
28................	*228	†102	126	206
29................	260	272	198	255
30................	260	*85	220	204
31................	*120	*187	†40	*152
Total	3,990	4,136	3,939	5,652
Average per shift	65.4	62.6	58	79.7

*Two shifts.
†One shift.

Bronx Borough Makes Its Own Asphalt Repairs—Effects Big Saving

Erects $11,000 Plant and Hauls by Motor Truck—Cost Over One-Third Less Than Lowest Contract Price

ASPHALT PLANT HAS NEAT APPEARANCE

MATERIALS HAULED BY BACK-DUMPING 5-TON MOTOR TRUCKS

THE Borough of the Bronx, New York City, has 2,529,391 sq. yd. of asphalt pavement. Much of it is subject to very heavy traffic and has been laid many years. Up to the last year the borough had been doing its repair work by contract. The best price obtained for surfacing only was $1.32 per square yard. Last season it built an $11,000 asphalt plant by force account and made its own repairs. The cost of repairs, despite the difficulty of locating the right men for the work under civil-service regulations, was reduced to 90 cents per square yard.

ASPHALT PLANT

The plant is located on the Bronx River at a point practically equidistant from the extreme points of the asphalt pavements in the borough. There are two long stretches of road, on upper Broadway and White Plains Road, which are remote, but these are new pavements which will not require any considerable repair work for several years to come.

The plant consists of a Cummer semi-portable outfit, housed in a neat, though cheap, frame building inclosed with corrugated sheeting. The building is constructed in such a manner that it can easily be taken apart and moved to another location. There are two units, a melting kettle and a mixing unit, operated by means of a 25-hp. electric motor, direct connected. The motor operates the dryer, two elevators, the mixer and the dust collector. A small 1½-hp. electric motor operates the barrel elevators. The stone dust is brought to the mixing platform by the latter.

A single mixing box, having a capacity of 5 cu. ft., is used in mixing both binder and wearing surface. The plant was guaranteed to produce 65 tons of mixed material in an 8-hr. day, and has more than met this requirement, 70 tons per day having been produced.

The plant force consists of a foreman in charge, a mixer man and a helper, on the mixing platform; a fireman, attending to the fires under the dryer and the asphalt kettle; one general utility man, oiling, assisting in the preparation of tickets, loading coal, wood, cement, etc.; two men at the cold-sand elevator to feed sand and stone to the dryer, and two watchmen.

The mixed paving material is hauled to the street in five horse-drawn bottom-dumping trucks and two 5-ton back-dumping motor trucks. The latter have given very good service, particularly as they are used not only for hauling the hot asphaltic material and the excavated material from the street, but, on occasions, are used for transporting paving blocks, sand, brick, stone, cement, lumber and the various materials used in the maintenance of the sewers and highways of the borough.

For convenience in loading the mixed material, the mixing unit was erected on piers to provide a clearance of 9½ ft. under the mixer slide.

The Bronx River is navigable by barges so that the materials can be brought up by water when convenient.

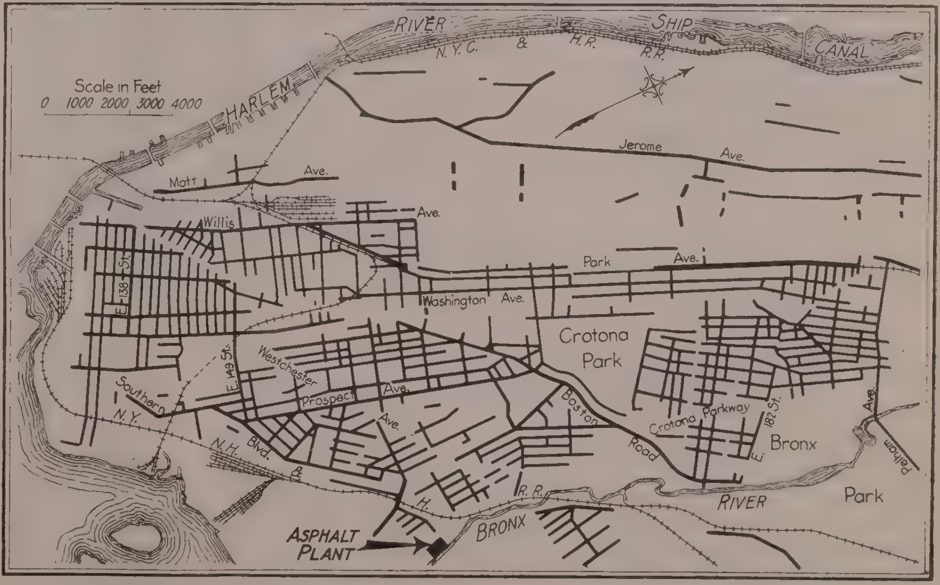
There are two repair gangs, each totaling eighteen men, and consisting of a foreman, steam-roller engineer, roller boy, two rakers, a tamper, a smoother, and nine asphalt workers and two watchmen. They begin on certain routes and work along them until the repairs are finished. There is no jumping from point to point.

The trucks are so regulated as to their working hours that the repair gangs are not kept idle at any time awaiting material. One truck is at the asphalt plant at 6.30 a. m., so that it arrives at the work loaded by the time the men start. This truck returns to the yard early, and does not stay out more than the regular 8-hr. day.

MOTOR TRUCKS USED FOR HAULING

Two 5-ton Mack trucks are used. These back dumpers elevate the load for dumping by their own power. Sometimes both the binder and the top course are transported in the same truck. During the last season 53,400 sq. yd. of surface repairs were made. The cost per square yard, including labor, material, etc., depreciation and interest on plant and trucks, but excluding other overhead, was 90 cents. These other overhead items are not included in the contract figure cited in the first paragraph, so that the costs are incomparable.

The repair work is under the direct supervision of John P. Binzen, engineer of maintenance, highways and sewers, of the borough. John G. Borgstede is commissioner of public works; R. H. Gillespie, chief engineer of sewers and highways, and J. Stewart Wilson, superintendent of highways. The asphalt plant was designed by Mr. Binzen and erected under his direction. by employees of the highway department.



PLANT IS PRACTICALLY EQUIDISTANT FROM EXTREME POINTS OF ASPHALT PAVEMENTS

Success of Society Depends on Service of Every Member

Application for Membership Should Carry with It Not Only Willingness to Give but Actual Co-operation

EDITORIALLY the Engineering Record, on page 437 of the issue of April 1, asked the question: "Why does an engineering society exist?" and gave as the answer that the society exists to render service to its members. Edmund M. Blake, in a paper published in the April *Journal* of the Boston Society of Civil Engineers, asserts that the service of the society to the member will naturally follow if each member is not merely *willing* to give service to the society and the engineering profession in general, but *actually does give* such service. Some of Mr. Blake's conclusions follow:

SOCIETY DEPENDS ON ITS MEMBERS

The building up of an engineering society depends upon the correlated service of every member. Application for membership should carry with it not only the willingness to give, but the intention of so doing. Engineers are following the greatest profession in the world, and have adopted it as their life work only after careful thought, deep consideration of all the branches of life's activities, and, usually, a long scientific or practical preparation. If they are not loyal to engineering as a profession they should abandon it at once. If they are loyal to it, then its upbuilding and strengthening should be one of the primary motives of their work.

REPRESENTS CO-OPERATIVE EFFORT

An engineering society represents a co-operative effort by the engineering profession to consolidate its members into a concrete and unified organization for the upbuilding and strengthening of the profession; for the benefit of personal contact and professional interchange of engineering knowledge, ideas and advice; for the purpose of commanding a broader recognition and a higher valuation of the engineering profession by the public, and for the publication and dissemination of the best in engineering theory, design and practice, and a compilation of data.

The individual member should be instilled with the true spirit of service, with an ambition to contribute toward the accomplishment of these purposes more than his share, and with a very clear realization that his application for membership in the society is not accepted primarily as adding one more wheel unit to the installation, but rather in the nature of additional second-feet of flow to be credited to plant capacity.

With this conception firmly established in mind the engineer who joins the society will consider of first importance the question of what he can add to the society, and not of what he can get out of the society in return for his annual dues. Service for the society will follow and soon there will be no need of arguing the other side—that of the benefit to be received from membership in the society.

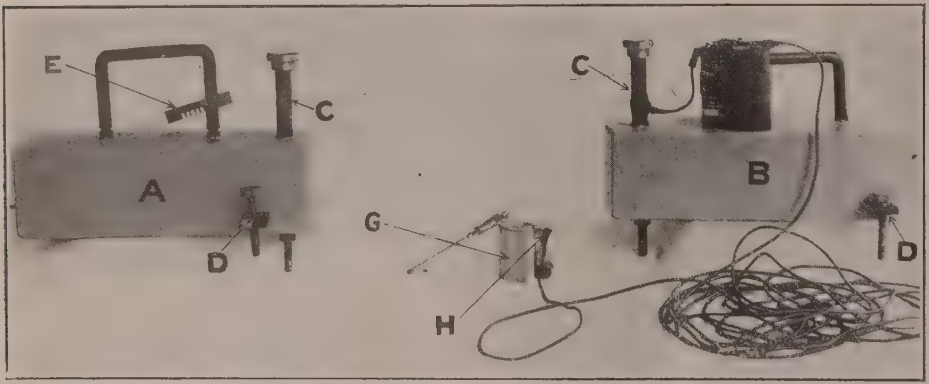
This conception will not foster any false valuation of present personal contributions to the society, but will create an ambition to make the net final contribution represent the maximum individual output, always remembering that the engineering society is one great concrete medium of contribution to the engineering profession.

New Device Measures Wear on Concrete Roads

Instrument Developed by A. T. Goldbeck Makes Possible the Accurate Determination of Changes in Roadway Surfaces

TO obtain definite knowledge of the wear on concrete roads a device has been designed by A. T. Goldbeck, engineer of tests, U. S. Office of Public Roads and Rural Engineering, which will provide a definite and fixed datum from which the wear on concrete road surfaces can be determined accurately from year to year. The instrument, as described by Mr. Goldbeck in the *Journal of Agricultural Research*, consists of a fine wire stretched tightly across the road at a constant height, together with an inside micrometer for measuring the distance from the surface to the wire. Measurements taken 1 ft. apart across the road permit the plotting of its cross-section. If these measurements are repeated at long intervals the change of cross-section, or the decrease in the thickness of the road, will be revealed. The accompanying illustrations show the instrument in detail and its method of application on the road.

WEAR ON ANY KIND OF ROAD SURFACE MAY BE DETERMINED BY INSTRUMENT



BUZZER SOUNDS WHEN CONTACT IS MADE BETWEEN MICROMETER AND WIRE

DETAILS OF APPARATUS

Pieces *A* and *B* are made of cement mortar and have embedded in them steel rods, *C*, drilled with holes slightly inclined with the horizontal. A fine piano wire about 0.01 of an inch in diameter is passed through these holes, and is stretched across the road from block *A* to block *B*. The tops of the rods are each provided with a disk-level bubble, so that when placed in position they may be adjusted to a vertical position. Block *A*, which is heavier than block *B*, is provided with two adjusting screws, *D*, for adjusting rod *C* to the vertical. Block *B* rests on two points only, one the lower end of rod *C* and the other the end of adjusting screw *D*. Constant tension is produced in the wire by the weight of block *B*, which is pivoted about the bottom of rod *C* and is adjusted to a horizontal position by means of rack *E*, provided at the end of the wire. As the weight of block *B* is constant, the tension in the wire, and consequently the amount of sag for like spans, must remain the same. A definite and fixed datum is thus provided, which should remain constant from year to year, and which is very easily established by merely placing the end blocks of the apparatus in their proper position on the road.

The bottoms of rods *C* are spherical in shape, and, when in use on concrete roads, they rest on the flat tops of bronze plugs cemented in the road surface. These plugs are ½ in. in diameter and are 1¾ in. long. They are set ¾ in. below the surface, and their tops are protected by means of a brass pipe plugged with a bituminous-sand mixture during the long intervals between readings.

LINE MARKED WITH CHALK

In obtaining the wear measurements a chalk line is first snapped across the road between the bronze plugs, and the points at which it is purposed to take readings are marked on this line. At these points a steel block, *G*, 2 in. in diameter, is placed, in order to avoid measuring the small local inequalities in the road surface. In the top of this block a flat-bottomed cylindrical recess is made, and an ordinary inside micrometer is held in the recess, while its upper end is adjusted to contact with the steel wire stretched across the road. An electric buzzer, *H*, is mounted on the side of this block, and, when contact is made between the micrometer and the wire, an electric circuit is completed through it. Readings may be taken to the nearest 0.001 in., although this degree of accuracy will not be necessary.

Wet Ground Tunneling Facilitated by Grouting in Advance of Heading

Third Article in Series Describing Aids to Progress in Bad Ground and Methods of Filling Cavities Over Arch of Bore

By JAMES F. SANBORN
Division Engineer, Board of Water Supply, New York City

IN the hard rock tunnels of the Catskill aqueduct water was often encountered in the drill holes while driving the heading, coming out under a pressure of 100 lb. to the square inch or more. A wet tunnel is always slower and more expensive to drive than a dry one, as it is more difficult to keep the men working under a wet roof, and the necessity of pumping the water is an additional expense. However, in only two cases on the Catskill aqueduct work was an attempt made to reduce the flow of water in tunneling by the grouting process. In shaft sinking, as described in last week's issue of the Engineering Record, page 549, water is often reduced or entirely stopped by grouting the drill holes, and this process might be used more commonly in tunneling, but for the fact that a tunnel superintendent never likes to stop drilling and shooting to bring in a grouting rig, hoping always that the water will not increase on the next shot. In the cases described the grouting in the heading was not altogether a success in the first instance, but in the second case a flow of about 300 gal. per minute was cut off which would have had to be pumped 1100 ft. up a shaft for a period of a year or more. The grouting in this case resulted in a direct saving to the city in pumping charges of $4000 per month.

While driving the heading from shaft 4 of the Rondout siphon in High Falls shale, a flow of 350 gal. per minute was struck while drilling in the heading. Grouting was at first unsuccessful, as the shale was too weak to stand the pressure of 250 lb. per square inch, but on a subsequent attempt about 75 gal. per minute was cut off. Drilling was resumed and two holes tapped water-bearing seams about 14 ft. from the face, yielding a flow of 75 gal. per minute from one hole and 300 gal. from the other. These holes were successfully grouted and reduced the total water pumped from 975 to 600 gal. per minute at the end of the year. Part of the decrease was due to the grouting and part to the reduction in groundwater head. This heading was driven up a 15 per cent grade so that the water ran freely away to the large pumps at the shaft. With the water collected at the heading, it might have paid to grout off the leakage before resuming the driving, but as pumps were in place and the contractor was paid for pumping, less effort was undoubtedly made to shut off leakage by grouting than might have been the case under other conditions. If a bulkhead had been built against the heading to permit the use of the high grouting pressures which the case required, better results would, no doubt, have been secured, as the shale rock was too weak to withstand the grouting pressures.

When the tunnel from the east shaft of the Hudson River siphon had progressed about 300 ft. a slight flow of water issued from the top dry holes. On shooting the cut, a stream of about 180 gal. per minute was struck, and after a few days it increased to 425 gal. per minute. The shaft was flooded and after it was pumped out a 4-in. pipe was placed in the apex of the cut and a concrete bulkhead built around it. The flow at this time was 210 gal. per minute. This line was piped up the shaft to the second pump chamber, and the water, through its own pressure, was raised to an elevation of 800 ft. above the seam at the heading. On resuming drilling in the heading eight pilot holes from 10 to 20 ft. in length were drilled, five of them making water and discharging a maximum of 550 gal. per minute. It was decided to grout the water-bearing seams, as it was the general opinion that water in great quantity would be struck when excavation was resumed. A concrete bulkhead 5 ft. thick, reinforced by rails, was built across the face of the heading, with grout pipes extending through the bulkhead. The grouting was first undertaken, using a Cameron pump and very fine neat grout. After 42 bags of cement had been pumped into the heading the pump valves were so badly worn that the pressure could not be maintained. A pressure of 450 lb. was developed by the pump.

The grout was afterward injected by pumping water into a Canniff grout tank in which the grout was first mixed, forcing the grout into the rock by water pressure. This method was successful and nearly all the water flowing from the drilled holes was shut off. Fully 1000 lb. per square inch water pressure was obtained by the pumps. After the grout had been allowed to set the heading was shot. Several rounds were taken from the heading without any increase of water. The seam was found as anticipated, striking north 60 deg. west and so effectually filled with grout that the water was cut off even after excavating past the seam. The width of the seam varied from ¼ to ½ in. In the roof a small amount of water dripped down, but otherwise there was no leakage.

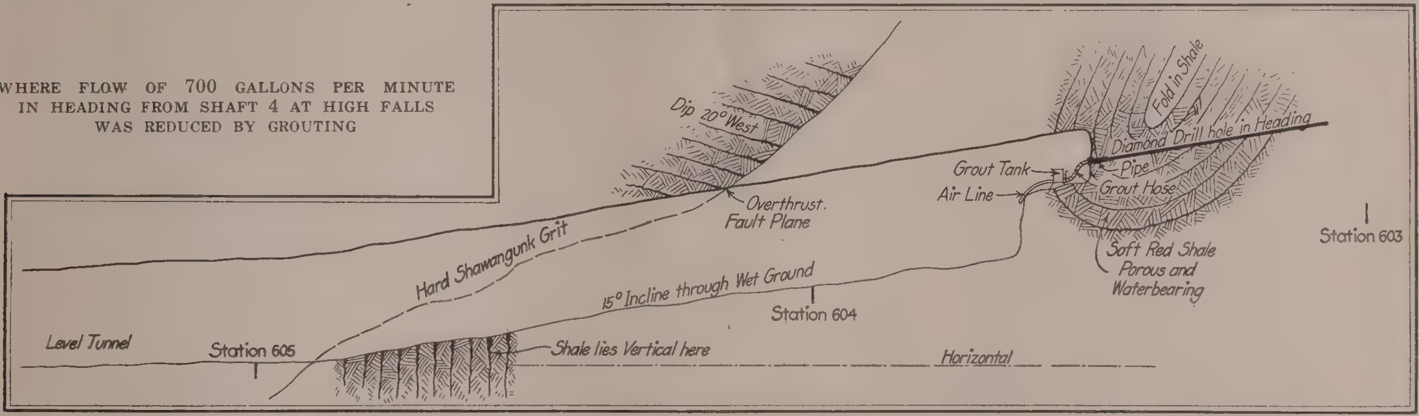
Upon excavating the bench some days later the seam appeared to be well filled with cement in the bottom. After the bench excavation had progressed 13 ft. beyond the original leaking fissure, one of the bench holes struck a flow of about 110 gal. per minute, but after the bench was shot the flow disappeared. It was supposed that the seam was plugged by the displacement of the rock and the fine debris forced into it.

Grout was used with two principal objects in view—to complete the filling of spaces not filled by the concrete and form a backing against the hydrostatic pressure for the purpose of preventing the rupture of the concrete lining, and also to fill seams in the rock and expansion spaces in the concrete lining to serve the purpose of waterproofing, by preventing the escape of water when the tunnel is in service.

The space over the concrete arch in rock tunnels cannot be completely filled, as the soft concrete packed into the key settles away by gravity, leaving a void as much as 2 or 3 in. high above the concrete arch. Places where the rock breaks high are filled as completely as possible, and afterwards completed by injecting grout in the form of mortar. Experience has shown that this grout is very effective; no voids of considerable size are left. Where dry packing is used in bed ground which requires a support of permanent steel ribs and lagging, grout is injected to fill the spaces between the pieces of rock forming a rubble or cyclopean concrete.

Drains and drip pans placed between the rock and the concrete lining to waterproof the soft concrete against the incoming water from rock seams, is another illustration of that class of cavities of large size where thick mortar grout is used as a backing for the concrete. In this case the water is discharged through weep pipes through the freshly placed concrete to prevent the water, which is frequently under high pressure, from washing and disintegrating the lining before it has set. When it is necessary to shut off this water after the concrete has hardened, grout is injected to fill the drains and pans.

The grouting of large cavities requires the use of 2-in. pipes, through which the


WHERE FLOW OF 700 GALLONS PER MINUTE IN HEADING FROM SHAFT 4 AT HIGH FALLS WAS REDUCED BY GROUTING

grout is injected. They must be carefully placed to lead the grout to the lower part of the cavities. Vent pipes leading from the summits of the cavities are placed during the period of concreting to permit the escape of air and water as the grout is injected. These vents further serve the purpose of telltales to show when the cavity is completely filled with grout.

For filling cavities of large size, sand and cement grout in a mixture of one part of each is used, mixed with a quantity of water just sufficient to produce a grout not too thick to be easily pumped.

Work of grouting large cavities divides itself under two heads. First, grouting dry cavities displacing water; and, second, grouting wet cavities displacing water. When both wet and dry cavities lie in close proximity and are connected, the best results are obtained by grouting the dry cavities first and permitting the grout to set before attempting to fill the wet cavities. If the wet cavities are grouted first, the water ordinarily shifts to some nearby dry cavity, thereby multiplying the number of wet cavities to be grouted.

GROUTING DRY CAVITIES

When considerable stretches of tunnel are to be grouted, the usual method is first to grout the space over the arch and the dry packed stretches, using an air pressure of about 40 lb. to the square inch, and, after this grout has set, to make a second trip through the tunnel to complete the grouting of any spaces over the grout first placed and also to grout all pipes and pans carrying water.

The first, or low pressure grouting, employs thick 1:1 sand grout, while the second, or high-pressure grouting, employs only neat cement grout injected generally under a pressure of 300 lb. to the square inch. Entirely different methods are used in the two processes and a special plant is required in each case.

LOW-PRESSURE GROUTING

In the low-pressure grouting of the Catskill aqueduct tunnels about 90 per cent of all the grout was placed. The procedure was as follows:

A connection was made to a grout pipe at the end of the arch, and batch after batch of grout injected. Water flowed from the grout, and vent pipes ahead, which were closed in turn as soon as grout appeared. Where it was intended to grout again valves were placed on the pipes and these were closed, but in general the flow of grout from the vents was cut off by driving in conical wooden plugs. High-vent pipes, which were to be subsequently opened and regrouted on the second grouting, were closed by driving a wad of oakum back into the far end of the pipe. At the end of the shift the oakum was removed by means of a wormer, or if the pipe was filled, it was drilled or rodded out preparatory to the high-pressure grouting.

It was customary, in grouting the over arch space, to let the grout run ahead from 200 to 300 ft. before moving the grouted connection forward, as it was found that by pushing the grout under pressure it filled the spaces better and made a complete contact with the roof.

In a number of instances the tunnel roof broke very high and vent pipes 15 to 20 ft. long were used, extending into high summits above the roof of the tunnel. Pipes for introducing the grout into such high places were carried only to the top of the concrete and the grout injected through these, as it was found that the sand and cement separated considerably after grouting was done through the high pipes first and allowed to flow down through the dry packing.

SHRINKAGE CRACKS

The concrete lining of the aqueduct tunnels adheres to the rock up to the quarter bends of the arch, bonding to the walls and preventing longitudinal movement which would take place due to changes in temperature of the concrete. In the upper portion of the arch, however, the concrete is not in contact with the rock and at the joint between arches placed in successive days' work a crack invariably appeared, due to temperature changes.

When the space over the arch was grouted these transverse cracks were large enough to permit the flow of grout, and after leaking grout for a time, they are generally filled satisfactorily. It is found extremely important that no water pressure be allowed to accumulate on the soft grout, as the thin layer filling the expansion crack is invariably washed out by an accumulation of ground water pressure before it has had a chance to harden. It was a common experience after the ground water had accumulated to see joints showing a slight seepage at such expansion cracks below the quarter points of the arch where the cracks would show thin where the grout had been unable to fill them, whereas the crack in the crown of the arch, having been completely filled by grout, showed no water. Honeycomb spots on the arch concrete were also completely and satisfactorily filled with grout, so that very few such places were found to leak water even after gages placed on grout pipes through the lining registered a pressure of 100 lb. to the square inch.

WET ARCHES

In the case of considerable leakage from the rock when the tunnel was driven, water entering from the rock was carefully panned and the water led by pipes through the concrete, but it sometimes happened that the panning was not successful or the seams admitting water extended considerably beyond the edges of the pans. In the case of wet arches the method first tried was to grout the dry arches on either side, leaving the grouting of the wet arches for a subsequent operation. It was found better, however, not to attempt to make a separate job of the wet arches, but to grout them continuously with the adjacent section, as experience proved that the grout was more likely to set, since the water from the wet arch followed along with the grout and found its way to vent pipes in adjacent sections. During the process of low-pressure grouting the vent pipes were always left open in order to prevent the accumulation of a head of water on the fresh grout.

ROCK SEAMS

The grouting of rock seams outside of a tunnel lining is, perhaps, the most difficult type of grouting. In the first place, it is hard to drill holes which will give adequate access of the grout to the rock seams. In the drilling operation, even though the hole encounters the crack in the rock which carries the water, the pounding action of the drill is liable to calk the cavity with powdered rock, so that when the grout pressure is applied it will not enter freely. However, a great deal of this work was done with marked success in cutting off leakage into the tunnels and, conversely, in preventing the escape of water from the tunnels in service. The deep-seated pipes from which grouting was to be done were left open during the low-pressure grouting of the tunnel arch and dry packed sections, in order to vent the water and insure proper setting of the low-pressure grout.

High-pressure grouting of the rock seams advanced from one end of the wet section to the other. Usually the holes near the invert were filled first, the pipes in the sidewalls and then in the arch being filled in turn. As a preparation for grouting, connection was made to a deep-seated pipe and the air pressure of 90 lb. to the square inch was turned on in order to force back the water in the rock seams, and also to clear out any rock chips or debris. The application of air also gave an indication of how large a section could be filled from a particular pipe connected, as the adjacent pipes would show pulsation when affected by the air traveling through the rock seams. To get a definite idea of the rock water pressure a gage was attached ahead of the grouting.

THIN GROUT USED

On starting to grout a very thin mixture was used, about ¼ of a bag of cement and a tank full of water. Air pressure was applied, sufficient to inject the grout, and after 50 batches had been injected, if the tank pressure remained low, not over 100 lb. to the square inch, the mixture was thickened by doubling the amount of cement, and the grouting continued. If the pressure required still continued low after injecting another 50 batches, the amount of cement was again increased, and these processes continued until a rise in the air pressure was required to force in the grout, showing that the seams were beginning to fill up. From this time on the consistency of the mix was held constant. The object of the above method was to suit the grout to the size of the seam without prematurely plugging it.

Grouting was continued until the pipe refused grout under a pressure of 300 lb. to the square inch, when the pipe was drained out and closed with a batch of thick grout. It frequently happened that neighboring pipes would show less and less flows of water injected with the grout from the hole where the connection was made; the seams, apparently, were filling for a considerable distance away.

As a rule, there is a chance to inject grout into rock seams, and where the chances are poor, no definite rule can be given. The inward leakage is, in a sense, an index of the amount of grout that can be injected.

For injecting grout into rocks which show a seepage, but no considerable flow of water, three arrangements of grout piping were tried.

1. Drilling in enough deep-seated pipes to collect the water and protect the mortar from washing.
2. Putting in a drip pan with independent additional deep-seated pipes to the rock seams.
3. Using drip pans alone, grouting them with thin grout, then draining the pan and filling it with thick grout to complete the backing.

Experience seemed to indicate that the second method was a little the best, although in most cases the third method gave complete satisfaction in cutting off the water.

The accompanying table gives data bearing on the effectiveness of the concrete lining backed up and made tight by grouting to stop the inward leakage:

How Grouting Stopped Inward Leakage

Tunnel	Length, miles	Depth below water, feet	Inward leakage during excavation, gal. per min.	Inward leakage after lining is completed, gal. per min.
Rondout siphon....	4½	450	3,600	56
Wallkill siphon.....	4½	300	1,100	75
Moodna siphon.....	4½	1,100	2,000	85

Grouting Shaft Closures

Many of the construction shafts sunk for driving the Catskill pressure tunnels were sealed for 50 ft. or more above the finished waterway by concreting them solidly against the rock. The volume of these concrete plugs vareid from 450 to 700 cu. yd. and the question arose as to the amount of shrinkage that would take place in such a body of grout during the process of setting. In order to fill any space that might form between the concrete of the rock, horizontal ring pans of sheet tin were placed at frequent intervals against the rock and were completely grouted through pipes, provided for the purpose, after the concrete had set. These grouting pans served a two-fold purpose. First, to collect water seeping from the adjacent rock, thus preventing water from washing channels through the newly placed concrete, and second, to furnish a grouting space for filling any shrinkage crack or honeycombed place that might result. When grouting these pans, it was observed in several cases that air would blow from one pan to another, showing that a connection already existed, which was completely filled by the grouting operation.

At the bottom of almost every shaft there was a shower of water resulting from leaks under the shaft above, and special pains had to be taken to protect the concrete and make provision so that the grouting rings and drains should be effective when grouting was undertaken. In no case has any considerable leakage come through a shaft plug since the aqueduct was put in operation, showing that the grouting was effective.

[*The End.*]

Presents Plan for Development of Canada's Capital

Federal Commission Would Form Separate District for Ottawa and Hull, and Create Imposing Capital City

A REPORT looking to the development of a capital city for Canada befitting the size and importance of the Dominion has just been presented by the Federal Plan Commission, created in 1913 to study the situation. The report recommends the separation of Ottawa and Hull into a separate federal district, and the molding of the two cities into an appropriate governmental seat. The plan sets aside 120 acres for government grounds, in addition to that occupied by the buildings, and other areas for parks and other purposes. The recommendations also embrace streets, bridges, railways and water transportation. These notes are taken from the *Canadian Engineer*, in which is a more extended abstract of the report. Some of the specific recommendations are as follows:

Central Open Space

The central area in the city will be a great open space running southward from Chateau Laurier and the Plaza Bridge, and at the same level. Canal, railway and cartage traffic will be on a lower level. The present Grand Trunk station will be enlarged into a Union Station. The present post office will be removed and an imposing one erected facing the Plaza. A new city hall and various law courts and registry offices will also be constructed facing the Plaza.

The land west of the parliament buildings will be used for departments of the government. Here, in time, a second group of buildings will be constructed to harmonize with those on Parliament Hill. These buildings will house the chief governmental activities, but bordering on the east of Major Hill Park and stretching along Sussex Street there will be other buildings less ornamental in character and built for practical utility.

The plan contemplates the devotion of only about 120 acres to government buildings, over and above that actually occupied by the buildings themselves. For this purpose Washington uses about 300 acres; but less land is required at Ottawa, owing to the advantageous position on the high banks of a river.

Streets

A great thoroughfare connecting the east and west portions of the city will be made of Laurier Avenue, which will be widened to 90 ft.

To provide better connection between the two portions of the business section of Ottawa, a new diagonal street will be constructed which will be carried over the railway and canal by a viaduct. Somerset Street will be widened and developed as a cross-town artery. Numerous other streets and roads will be widened and improved. Street-car congestion will be removed wherever necessary. A street car subway under Sparks Street or Wellington Street is recommended, thus removing the cars from Sparks Street, which is narrow and will be greatly congested. Considerable highway construction is recommended.

It is recommended that trunk arteries be laid down immediately in proper location, so that outlying areas will be built up to conform properly with them. The present park system is to be improved and other park areas acquired.

Bridges

Five new bridges will be built across the Rideau River and also five across the Rideau Canal. Four new bridges are recommended for construction across Brewery Creek and the Gatineau River. It is proposed to park the banks of Brewery Creek, the Gatineau River and the Ottawa River, interfering as little as possible with existing industries.

Three bridges for the Ottawa River are included in the plan; one being at Little Chaudiere Falls; another, of monumental character, to connect Ottawa with the municipal center of Hull; and a third just below the mouth of the Gatineau River. The commission says that the bridge leading from the municipal center of Hull should be a high-level bridge, and that it would be desirable to provide two levels, one for transportation and one for general traffic, although this bridge is now shown on the plan as having but one level. The present traffic conditions surrounding Victoria Bridge, say the commissioners, suggest this high-level bridge as an improvement for the near future.

A tunnel will be built under the city, connecting the railway entrances from east and west, and all trains will operate through this tunnel. Two general freight areas, one at the east and one at the west side, with necessary depots, are recommended. Industry will be segregated into certain areas, and the height of buildings will be controlled, in order to insure the government buildings being the dominating groups.

The overflow from the Rideau River will be controlled by the removal from the river channel of the old wooden piers and loose stone, the removal from the river bed of boulders, the dredging of channels through the shoals, the raising of the Minton Bridge, the opening of a channel through the embankment of the Canadian Pacific bridge, and the widening of the channel past Maple Island.

It is recommended that the government acquire as a national park upward of 100,000 acres to the north of Ottawa.

Railways and Waterways

The report includes a comprehensive study of the local railway situation, and recommends that the railways within the district be placed under the control of the governing body of the federal district. Electrification of the unified system is suggested, with terminal operation and control, the district to acquire by purchase or agreement all trackage and terminals within its territory. Grade separation, requirements for expansion, obstacles placed in the way of growth by present railway situation, present traffic facilities and operation, growth of traffic, future freight-handling systems, and numerous other topics also are discussed in the report.

Specific recommendations are made for water terminals and for the development of the waterfront for commercial purposes wherever possible, care being taken that no real sacrifice will result to existing business interests.

Recommendations are made that the canal be retained in its present location; that the clearance for fixed bridges be established at 12 ft. instead of 30 ft., as at present; that the canal be developed to afford recreational facilities; that no more industrial developments be permitted to take place along the banks of the canal between the Rideau River and the Ottawa River; and that as soon as possible such industries as now exist along this stretch of the canal be removed to other locations.

The members of the Federal Plan Commission are Sir Herbert Holt, chairman; Sir Alexander Lacoste, K. C. Montreal; Frank Darling, Toronto; R. Home Smith, Toronto; and the mayors of Ottawa and Hull. The commission was created by an order-in-council Sept. 12, 1913, it being provided that the government should pay half of the cost of the plan, and that the other half should be paid by the two cities, according to population, the municipal authorities having expressed their desire to co-operate with the government in the work. E. H. Bennett acted as consultant on city planning and E. L. Cousins as consulting engineer.

Tests of Hollow-Tile, Flat-Arch Floor Slabs Show Effects of Concentrated Loads

Table of Safe Loads Compares Test Results with Present Practice—Tie-Rod Stresses Measured—Empirical Formula Proposed

By CLYDE T. MORRIS
Professor of Structural Engineering, Ohio State University, Columbus

TESTS of hollow-tile, flat-arch floor slabs for the purpose of finding both the ultimate strength and the width of distribution of concentrated loads, and for determining the actual stresses in the steel tie rods, have been made during the last few years at the civil engineering laboratory of the Ohio State University. The results of these tests of thirty-five arch slabs appear to show a distribution of the concentrated load to the two middle rows of tile only, leading to the conclusion that it is not safe to consider more than two 12-in. rows of tile as supporting a load concentrated on one square foot. A comparison is made between the results of these tests, using an empirical formula based upon them, and the values in tables of safe loads often adopted in practice. The measured tie-rod stresses seem to warrant the conclusion that an effective depth of ⅞ the depth of the tile would be a perfectly safe assumption in the design of tie rods.

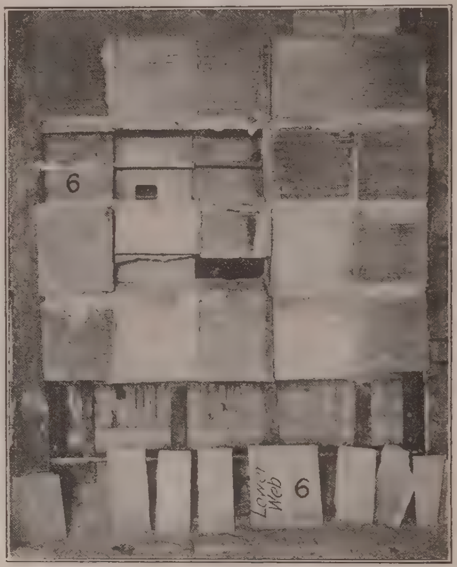
TABLES OF SAFE LOADS USED

Hollow-tile flat-arch construction is widely used for floors of fireproof buildings, yet methods of computing stresses in such floors have never been satisfactorily developed, and the design of these floors at present depends almost entirely on tables of safe loads published in various handbooks. Practically all of these tables have as a basis tests made and published by the National Fire Proofing Company. The loads are always given in pounds per square foot uniformly distributed, and practically no information is available concerning the action of these floors under concentrated loads. Probably the severest test to which such floors are subjected in practice is the passage over them of such heavy loads as office safes and trucks carrying heavy machinery. Most specifications for buildings require, in addition to safety for a certain load per square foot, that the floor must be safe for a given concentrated load on a limited area.

The reduction of a concentrated load to a uniform load per linear foot which will give the same center moment as the concentrated load is a simple matter. But in a floor of indefinite width, which is the common case confronting the designing engineer, what width of floor may be considered as effective in carrying a concentrated load? So far as the writer has been able to find, the answer to this question is not available.

CONCENTRATED LOAD APPLIED AT CENTER OF SLAB THROUGH SAND BOX

Another problem confronting the designer is the proper size and spacing of the tie rods in tile arch floors. These are usually spaced by some rule of thumb rather than by any calculation of the stresses which they have to carry. It is often assumed that the interior panels need few or no tie rods, on the theory that the thrusts of the adjoining arches balance each other. Other designers put the same number of tie rods in the interior panels as in the exterior. As far as the writer knows, no tests have been published in which the stresses in the tie rods were measured.



LOWER SIDE OF SLAB 9 AFTER FAILURE

The series of tests on tile arch floors here described was started in the Department of Civil Engineering at the Ohio State University as thesis work, under the direction of the writer, for the purpose of investigating these problems.

METHODS OF TESTING

Two 12-in. steel I-beams were used as floorbeams, between which the arches were placed for testing. The arches were built on the floor between planks as shown in one of the photographs, with the tie rods in place. They were laid up with 1:3 mortar, to which was added hydrated lime of an amount equal to 20 per cent of the cement. The arches were covered with cement sacks and kept wet for several days, and tested at an average age of 7 days. Most of the arches were laid up with the tiles end to end, but a few combination slabs with side construction keys and skewbacks were tested.

The day before the arch was to be tested the planks were removed and the I-beams slipped on in their place, care being taken not to disturb the rods or to break the bond between the rows of blocks. The ends of the arches were bedded in mortar on the I-beams, the nuts on the tie rods tightened up and the whole allowed to stand twenty-four hours before testing. This gave an even bearing of the tile on the beams.

CONCENTRATED LOAD APPLIED

In all thirty-five slabs were made and tested. The load in each case was applied over an area of one square foot at the center of the slab. This was accomplished by filling with sand a bottomless box 12 in. square and 6 in. deep and applying the load through a plunger 11 in. square resting on the sand. The plunger was loaded by means of an I-beam lever and a screw jack resting on the weighing table of a testing machine. Deflection readings were taken, and the character of the failure was noted in each case. In the last twelve arches tested the deformations of the tie rods were observed by means of a Berry strain gage.

Table 1 gives a summary of the results of all the tests. All slabs were four 12-in. tiles wide except in tests Nos. 2 (six tiles wide), 22 (two tiles wide) and 23 (one tile wide). The addition of the mortar joints makes the total width of the slab in feet a little more than the number of tiles.

ANALYSIS OF RESULTS OF TESTS

All of the arches tested failed by the crushing of the blocks of the two middle rows. These were crushed on top at the middle and on the bottom at the skewbacks. In many cases the vertical webs were crushed along diagonal lines between these points. In only thirteen out of the thirty-five arch slabs tested was there any evidence of injury to any of the tiles outside of the two middle rows. A comparison of the tests of the one, two and four-row slabs, and a consideration of the manner of failure above described, would lead to the conclusion that it is not safe to consider more than two rows of tile as supporting a load concentrated on one square foot.

HOLLOW-TILE SLABS FOR TESTING

The average load at which the first crack appeared was 30 per cent of the ultimate, and the least load showing a crack in any test was 16.4 per cent of the ultimate. This would indicate that the factor of safety of 7 used in the National Fire Proofing Company's tables is well chosen and could not safely be reduced.

The tile in the arch fails in the same manner as the concrete in a simple reinforced-concrete beam, and therefore the resisting moment for a given depth of arch should be constant. More tests are desirable along this line to establish this assumption. Table 1 gives the bending moments computed from the ultimate loads on the assumption of simple beam action, and average moments with a factor of safety of 7. The concentrated load was assumed to be distributed over two 12-in. tile rows only.

TABLE 1—SUMMARY OF RESULTS OF ALL TESTS

Test No.	Type	Span Ft.	Span In.	Ult. Load, Lb.	Max. Defl, In.	Max. Tie-rod Stress	Mom. in Ft. Lb. Per Ft. Width: Conc. Load	Dead Load	Total	Mom. / 7
					6-Inch Slabs					
1	End	4	0	4,625	0.842		2,312	45	2,357	
2	End	4	0	4,600	0.861		2,300	45	2,345	
8	End	5	0	3,000	0.370		1,875	70	1,945	
24	End	4	1	5,400	0.66	9,840	2,755	46	2,801	
25	End	5	1	3,900	0.42	8,400	2,478	72	2,550	
							Av. for 6 in.,		2,400	343
					8-Inch Slabs					
3	End	4	0	6,540	0.470		3,270	53	3,323	
4	Comb.	4	0	4,060	0.160		2,030	53	2,083	
7	Comb.	4	4	5,700	0.446		3.088	63	3,151	
9	End	5	0	5,800	0.808		3,625	83	3,708	
12	Comb.	5	4	7,000	0.340		4,667	94	4,761	
15	End	6	0	5.020	0.549		3,765	120	3,885	
18	Comb.	6	4	4,740	0.596		3,752	133	3,885	
26	End	4	0	7,500	0.24	6,000	3,750	53	3,803	
27	End	5	1	7,000	0.29	12,320	4,448	86	4,534	
28	End	6	1	6,750	0.84	16,000	5,132	123	5,255	
							Av. for 8 in.,		3,839	548
					10-Inch Slabs					
5	End	4	0	8,640	0.348		4,320	62	4,382	
6	Comb.	4	4	9,600	0.306		5,200	73	5,273	
10	End	5	0	8,200	0.560		5,125	97	5,222	
13	Comb.	5	4	10,760	0.696		7,173	110	7,283	
16	End	6	0	9,600	0.778		7,200	139	7,339	
19	Comb.	6	4	8,530	0.478		6,753	155	6,908	
21	End	7	0	9,840	0.405		8,610	190	8,800	
22	Comb.	5	4	10,700			7,133	110	7,243	
29	End	4	0	7,000	0.27	4.040	3.500	62	3,562	
30	End	4	10	7,500	0.65	8,000	4,531	90	4,621	
31	End	6	0½	10,950	0.52	10,200	8,270	141	8,411	
32	End	7	0	10,400	0.33	10,000	9,100	190	9,290	
							Av. for 10 in.,		6,528	932
					12-Inch Slabs					
11	End	5	0	9,590	0.267		5,993	110	6,103	
14	Comb.	5	4	12,430	0.762		8,287	125	8,412	
17	End	6	0	14,740	0.584		11,055	159	11,214	
20	Comb.	6	4	12,770	0.605		10,110	177	10,287	
33	End	4	10	10,300	0.50	7,920	6,233	103	6,325	
34	End	5	11	11,300	1.20	22,800	8,357	154	8,511	
35	End	6	11½	7,300	0.79	9,360	6,350	215	6,565	
							Av. for 12-in.,		8,202	1,172

TABLE 2—SAFE LOADS UNIFORMLY DISTRIBUTED IN POUNDS PER SQUARE FOOT
FACTOR OF SAFETY 7

Span ft.	Span in.	6-in. arch Eq.1	6-in. arch N.F.P. Co.	8-in. arch Eq.1	8-in. arch N.F.P. Co.	10-in. arch Eq.1	10-in. arch N.F.P. Co.	12-in. arch Eq.1	12-in. arch N.F.P. Co.
3	0	320	482	569	767	889	1,114	1,280	1,524
3	6	235	354	418	563	654	819	940	1,120
4	0	180	271	320	431	500	627	720	857
4	6	142	214	253	341	395	495	569	677
5	0	115	173	205	276	320	401	461	548
5	6	...	...	170	228	265	331	380	453
6	0	...	...	142	191	222	278	320	381
7	0	...	...	...	...	163	204	235	280

TABLE 3—MEASURED AND COMPUTED THRUSTS PER FOOT OF WIDTH

Test No.	Depth, in.	Span, ft.	Span, in.	Total load	Moment per foot	Stress in tie rods per foot	Calculated stress per foot	Per cent of calculated
24	6	4	1	5,400	2,755	4,920	6,290	
25	6	5	1	3,900	2,478	4,200	5,660	
				Average for 6 in......		4,560	5,975	76
26	8	4	0	7,500	3,750	3,000	6,430	
27	8	5	1	7,000	4,448	6,160	7,620	
28	8	6	1	6,750	5,130	8,000	8,800	
				Average for 8 in......		5,720	7,617	75
29	10	4	0	7,000	3,500	2,020	3,360	
30	10	4	10	7,500	4,531	4,000	4,350	
31	10	6	0½	10,950	8,270	5,100	7,940	
32	10	7	0	10,400	9,100	5,000	8,730	
				Average for 10 in.....		4,030	6,095	66
33	12	4	10	10,300	6,223	3,960	7,110	
34	12	5	11	11,300	8,357	11,400	9,550	
35	12	6	11½	7,300	6,350	4,680	7,250	
				Average for 12 in.....		6,680	7,970	84

As a basis for an empirical formula we may use the equation for the fiber unit stress f in a solid rectangular beam,

$$f = 6M / bd^2 \qquad (1)$$

in which M is bending moment in inch-pounds; b is width in inches, and d depth in inches. This formula assumes a solid cross-section, and of course the actual maximum fiber stress in the tile would be many times that given by the formula on account of the openings in the tile.

Using the moments with the factor of safety of 7 given in Table 1, we get from this formula fiber stresses agreeing very closely for the different depths of arch and averaging about 53 lb. per square inch. From these tests the use of equation 1 with an allowable unit stress of from 50 to 60 lb. per square inch would seem to be justified. Table 2 gives safe uniform loads for several spans and depths, figured by equation 1, with $f = 60$, and in adjacent columns are given the safe loads from the tables of the National Fire Proofing Company.

In the tests made no concrete was placed on top of the arches. If one or two inches of concrete were used on top of the tile, as is the common practice in construction, there is no doubt that the strength of the floor would be considerably increased. On the other hand, the test arches were rather carefully made and would certainly average better than many floors laid by common labor in practice. Tile is a fragile material, and unless extreme care is exercised by the inspector, cracked and broken blocks are liable to be covered up in the work and not detected, so that it would seem advisable in this type of construction to use a liberal factor of safety.

COMPARISON OF SAFE LOADS

A comparison of the figures in Table 2 indicates that the safe loads given by the National Fire Proofing Company's table have a factor of safety of from 4.6 to 5.9, figured on the basis of the ultimate strengths shown in these tests and the assumed distribution of the concentrated load to two rows of tile.

It will be noted that in collecting the results of these tests no distinction has been made between end construction arches and combination; that is, arches with side construction keys and skewbacks. These tests indicate that one type is as strong as the other.

STRESSES IN TIE RODS

In the arches in which the tie-rod deformations were measured only two rods were used. The arches were all of four rows and the rods were spaced 25¼ in. apart, thus coming in the mortar joints on either side of the two middle rows of tile. The rods were ¾ in. in diameter and were made long enough to project about 2 ft. beyond the floorbeam on one end. A piece of gaspipe about 18 in. long was used as a washer on this end of each rod to transfer the thrust, as shown in one of the photographs. Each gaspipe had two holes drilled in one side large enough to admit the points of the strain gage. Thus the elongations of the rods were measured directly.

For these tests the floorbeams were set on other steel beams so that they would be free to move apart, held only by the tension in the rods and the friction on the bearings. The resulting tie-rod stresses given in Table 1 are the sums of the stresses in the two rods, or the total thrusts of the arches. As in the arch calculations previously given, the thrusts are assumed to be due to only two rows of tile.

Table 3 gives the measured thrusts per foot of width at the ultimate load and the corresponding thrusts computed from the bending moments by dividing by ⅞ of the depth as the effective depth. The measured thrusts average about 75 per cent of the calculated thrusts figured on this basis. The difference is probably due to bond between the mortar and the rods, which causes them to act like reinforcing rods in a concrete beam. Several authorities recommend the use of an effective depth 2.4 in. less than the depth of the tile in all cases. From these tests this amount of reduction is apparently unwarranted, and an effective depth of ⅞ the depth of the tile would seem to be perfectly safe. More tests along this line are greatly needed.

The work was carried on during the school year 1911-12 by R. C. Kempton and H. H. Nussmeyer and during the school year 1913-14 by H. J. Kohn and C. F. W. Schaufele. The tile for the tests was furnished by the National Fire Proofing Company.

Coating for Blueprint Paper Can Be Produced by Simple Method

As a result of the great increase in price of potassium-ferri-cyanide, which is extensively used as a coating material for blueprint paper, an economical method of preparing it has been devised by the Bureau of Chemistry of the U. S. Department of Agriculture. Before the beginning of the war this material could be obtained for 55 cents a pound. It now sells for $6 a pound, and it is exceedingly difficult to obtain in this country even at that price.

Potassium-ferri-cyanide can be produced by oxydizing a solution of potassium-ferrocyanide with chlorine gas. At the same time a small amount of potassium chloride is produced which, however, does not interfere with the color and the durability of the prints. It is unnecessary, therefore, to separate the potassium chloride by crystallizing the potassium-ferri-cyanide provided that the latter is to be used on the spot and soon after it is prepared.

A simple apparatus has been devised by the Bureau of Chemistry for preparing potassium-ferri-cyanide solution in this way. At the prevailing prices of materials, the solution can be made by this process at the cost of approximately $2.80 per pound, calculated on the dry salt basis. At the prices which prevailed before the war, which may be regarded as normal, the cost would be approximately 35 cents per pound.

Short Highway Courses Attract Practical Men and Serve Useful Purpose

Consensus of Opinion of Those Holding Courses and of Those Who Attended Indicates That They Make for Good Road Building

BELIEVING that there is a growing interest in the short courses in highway engineering being offered by a number of universities this journal has made inquiries as to the degree of usefulness they had attained. The consensus of opinion is such as would indicate that the courses serve a very useful purpose, that they attract all classes of men interested in road work—engineers, contractors, supervisors, material men and even the general public—and that those who attend feel that the time they have devoted to them has been profitably spent.

SESSIONS AT LOCAL POINTS

The course at the University of Illinois attracted and held the attention of contractors, who continued throughout the greater part of the two weeks. County superintendents of highways constituted the greater part of the attendance, but there were many others who appreciated the opportunity of getting together and freshening their knowledge of recent methods. F. H. Newell, head of the department of civil engineering, is of the opinion that there can be no doubt that the courses are advantageous and should be continued, not only as annual meetings, but with intermediate sessions at local points or correspondence in the nature of the popular correspondence courses in other subjects.

Ohio State University held no short course in highway engineering during the past year, due to an oversight in making the budget. It has held courses in the past which, according to E. T. Coddington, acting dean of the college of engineering, were found quite satisfactory. These courses were attended by all types of men engaged in road work, the contractors and so-styled practical men being well represented.

COURSES APPRECIATED

Cornell University holds a one-week course. This year's was the second. On each occasion men from the state highway department, contractors, road material men, county and town commissioners and state engineers attended. E. E. Haskell, dean of the college of engineering, is of the opinion that much good can be done by getting all the people interested together at least once a year for the purpose of hearing excellent papers and drawing out discussion, on important matters. Since the close of the school he has received numerous letters from men who were in attendance, expressing their appreciation of the efforts made and hoping they would continue.

The Maryland Agricultural College has given two five-day courses. At the first those in attendance represented all types, from men interested in roads in a general way to those actually doing road work. At the second there was a material change in the class, there being a large proportion of contractors and others keenly interested in road work. As far as its power of attraction for road superintendents is concerned the course has not been a success. T. H. Taliaferro, professor of engineering, believes this is largely due to the difficulty of impressing on the men the necessity of getting in closer touch with road work. The county engineers have manifested an interest in the courses, and a greater number of them attended the second than did the first. Professor Taliaferro is of the opinion that to produce the best results from the type of course given at his college it will be necessary to reduce it to a lesser number of days and make it much more intensive if possible. He also has under consideration the question of giving short courses in the different sections of the state with the hope of increasing the interest in them.

The University of Michigan has given a one-week short course for the past two years. At the first the attendance was between 130 and 140 and, at the second, just over 200. Every man in attendance was directly engaged in highway engineering work. No attempt was made to secure the attendance of men who were interested especially in city paving, and no lectures have been given at either of the courses by anyone directly or indirectly connected with any paving company, manufacturer of any materials, or the manufacture of machinery.

FRIENDLY RELATIONS ESTABLISHED

Of the course given at the University of Michigan, Thomas H. Noble, chairman of the Gross Ile (Mich.) Road Commission, a body appointed by the township board, which serves without salary and pays its own expenses, says, in part: "The school of instruction as given at the University of Michigan is decidedly popular in its character, conducted by Michigan men for the benefit of Michigan men and dealing with Michigan conditions. The embarrassment, which often prevents free and open discussion in meetings of this kind, is quickly dissipated by the atmosphere of free-masonry which is encouraged by the university, with the result that the best ideas of a very earnest and hard-headed body of road builders are exploited for the benefit of all."

Mr. Noble expressed the hope that the short course at the university will become a permanent institution. "Although still young in its influence," he declares, "it has already been the means of establishing confidential relations between the university and every community in the state which is interested in road improvement."

The attendance at the meetings has been liberal and characterized by enthusiasm and earnestness and the representation from remote sections was especially notable. Friendly relations through its influence have been established among officials in every sphere at the road building fraternity, which have stimulated a correspondence throughout the year that has helped to solve many important problems.

SUBJECTS DEALT WITH IN COURSES

The courses in general cover a wide variety of subjects. Financing is dealt with, as are road economics, maintenance problems, materials in the respective states and in general, design, preparation of plans, surveys, drainage, oiling, surface treatments, road building machinery and tools, and many other subjects. Among the speakers are numbered faculty officers, state highway officials, manufacturers, government road engineers, government chemists and others.

Reconstruction Needed on New York Highway Bridges

At Present Rate of Construction Many Years Would Be Required to Bring Them Up to 15-Ton Standard

THE marked increase in the weight of the individual loads passing over New York state highway bridges during the past 15 years has by far outstripped the provisions made to accommodate it. As noted on page 742 of the December 11, 1915, issue of the Engineering Record, less than one-third of the total number of highway bridges in the state are capable of sustaining a load of more than 8 tons. The reconstruction necessary to bring them up to the 15-ton standard required by present-day conditions would cost $30,000,000, according to data furnished by George A. Ricker, formerly first deputy commissioner of highways of the state. At the rate of construction during the years from 1911 to 1914 it would take from 17 to 74 years to attain that end.

LEGISLATION COMMITTEE

The legislation committee to investigate highway bridge conditions, the appointment of which was noted in the previous article mentioned above, has collected much valuable information relating to bridge and highway work, through correspondence conducted by its secretary, and has compiled data in regard to the bridge and highway laws of nineteen other states where the improvement of roads has been in progress for a number of years. Charles O. Pratt, chairman of the committee, has made a 500-mile inspection trip over a route that was selected as being typical of the same number of miles in any other part of the state. Two hundred and eighteen bridges were examined and reported upon. The findings substantiate the original conclusions in regard to the general conditions of New York State's highway bridges, and urge the need of new legislation at an early date to make possible the standardization of such construction.

At present there is no guarantee of security to the traveling public because of the absence of any general competent supervision. That the matter is of great importance is made evident by the constantly increasing number of claims against the state for damages in connection with the failure of bridges. There are now before the Court of Claims more than 100 cases involving an aggregate sum of $1,000,000. The failure of one bridge alone when a motor bus dropped through into a canal and 23 persons were injured has resulted in claims for nearly $200,000.

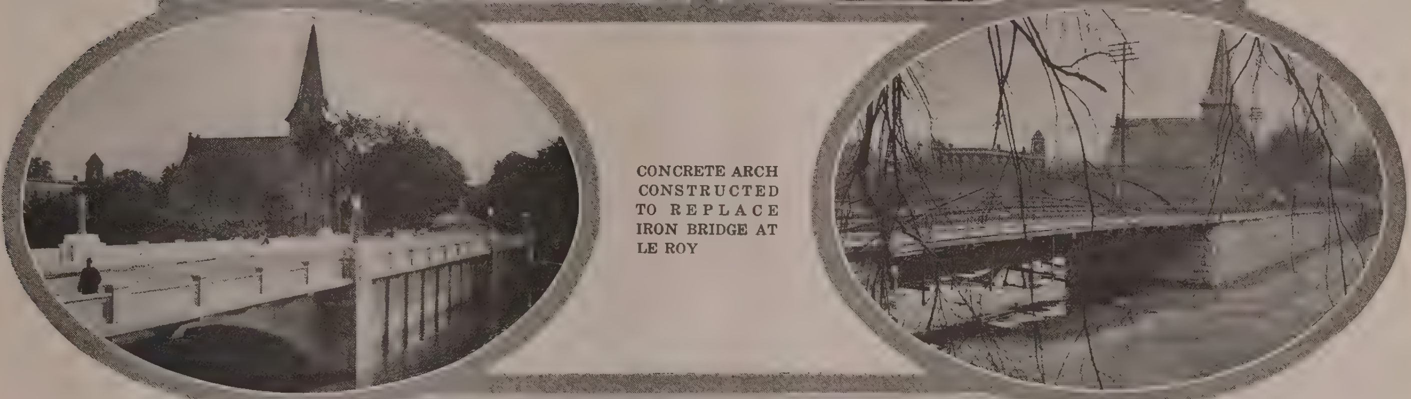
State Universities Add Courses in Lumber Study to Their Curriculum

Twelve State Universities have in the past year added college courses in lumber and its uses to their college curriculums. These schools are Syracuse University, and the following state universities: Maine, Wisconsin, Minnesota, Idaho, Washington, Oregon, California, Colorado, Georgia, Iowa, Pennsylvania and Massachusetts.

Work Already Done to Adapt New York Highway Bridges to Present-Day Demands

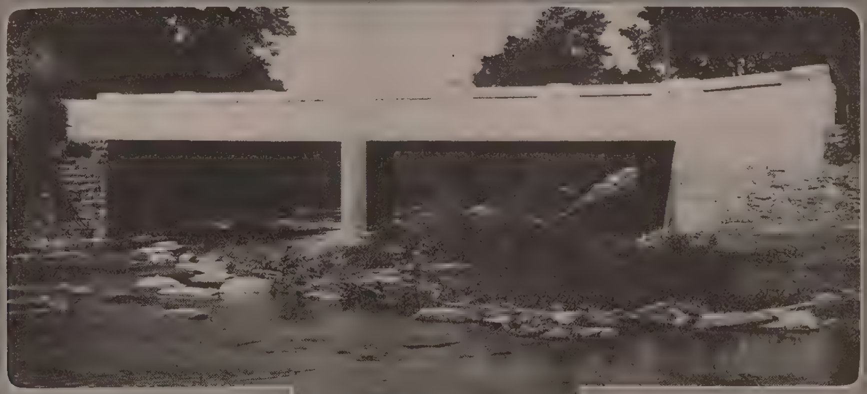
OLD BRIDGE OVER NORMAN'S KILL AT NORMANSVILLE

NEW STRUCTURE BUILT TO REPLACE OLD NORMANSVILLE BRIDGE

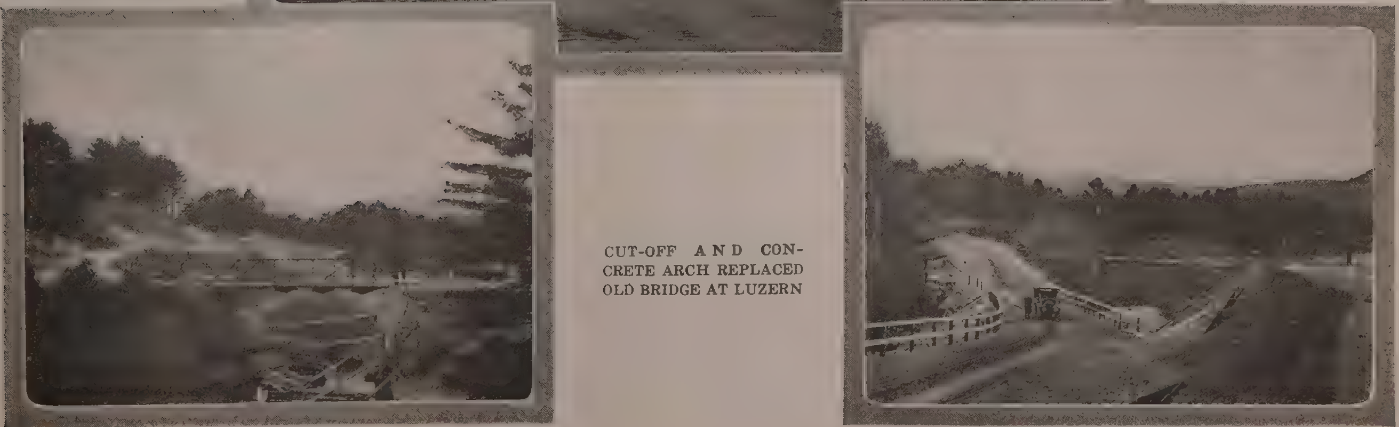


CONCRETE ARCH CONSTRUCTED TO REPLACE IRON BRIDGE AT LE ROY

OLD SINGLE SPAN BRIDGE AT POMFRET REPLACED IN 1914



NEW CONCRETE STRUCTURE AT POMFRET HAS TWO 35½ FOOT SPANS



CUT-OFF AND CONCRETE ARCH REPLACED OLD BRIDGE AT LUZERN

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Shall the American Society of Civil Engineers Move Its Headquarters?

SIR: Article 1, Section 3 of the constitution of the American Society of Civil Engineers says: "Its objects shall be the advancement of engineering knowledge and the maintenance of a high professional standard among its members."

Article 6, Section 2, states, among other things: "The board of direction *shall manage the affairs* of the society, in conformity to the laws under which the society is organized and the provisions of the constitution. It *shall direct the investment and care of the funds of the society*, make appropriations for specific purposes * * * and *generally direct its business.*" (The italics are my own.)

In view of the fact that probably not more than 2 per cent of the membership of nearly 8,000 care, particularly, where or how the society is housed, provided it accomplishes the purposes set forth in Article 1, Section 3, of its constitution, and the further fact that probably not to exceed 20 per cent of the membership have ever seen, or expect to see, the society headquarters, would it not be better to cease this unseemly controversy which, to a great majority of the membership, seems purely academic, and which bids fair to become the subject of heated contention, and place the whole matter where it properly and legally belongs—in the hands of the board of direction?

W. G. STONE.

Utica, N. Y.

SIR: With reference to the proposed removal of the headquarters of the American Society of Civil Engineers to the Engineering Building on Thirty-ninth Street, I beg leave to say that I am heartily in favor of the project.

My reason is that I believe in the fullest possible co-operation between engineers of all classes and in maintaining the closest possible touch between them. We form one profession and in order to have the greatest influence in affairs we should be recognized as one profession, and we should pull together and co-operate as far as possible. There is no doubt in my mind that these results can be better secured if the four national engineering societies are housed together in one building, in which other societies may also be accommodated, and which will be recognized as the engineering headquarters of this country. Not only will this plan secure a better and more economical utilization of rooms not often needed by one society, but it will bring about large savings in the conduct of the library, and increase its scope, avoiding duplication and making it the great engineering library of the country, if not of the world. I believe also that the dignity and standing of the engineering profession as a whole will be increased if there is one engineering building which can be pointed to as the center and headquarters of the entire engineering profession. Moreover, the location on Thirty-ninth Street is more convenient from a business and transportation point of view than our present location.

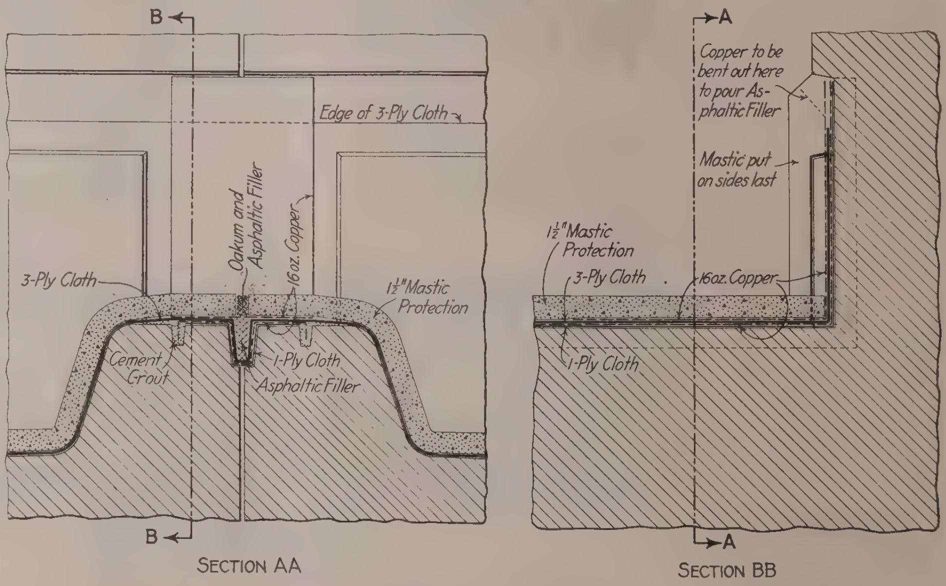
I can see no disadvantages in the plan sufficient to offset these advantages, and in fact I can see no disadvantages whatever. The American Society of Civil Engineers would not give up any of its independence of action or of administration, but would simply be in a position where it would be easier to act together with the other societies and where members of our society would be more apt to meet members of the other societies. The plan would, therefore, help to extend acquaintance and promote co-operation.

Cambridge, Mass. GEO. F. SWAIN.

How the Lackawanna Waterproofed Its New Viaducts

SIR: My attention has been called to the fact that misleading, or at least incomplete, statements of the facts with reference to the method of waterproofing the Martins Creek and Tunkhannock viaducts, on the new line which the Lackawanna just built west of Scranton, have been made by a firm advertising its waterproofing materials. Since the writer's name has been used in connection with some of these advertisements, and wholly without authority being given to the advertiser, he feels that it is essential at this time to make a short and concise statement of the facts, so that there need be no further misunderstanding as to the kind of materials used or how the work was done.

Both the structures above referred to were treated alike, the same waterproofing materials being used in each case. The only material difference is the fact that the Martins Creek structure is a three-track viaduct, with two separate lines of drain pipes in the floor system, while the Tunkhannock is a two-track structure, with but one line of drain pipes.



SECTION AA SECTION BB

EXPANSION JOINT DETAILS FOR LACKAWANNA RAILROAD'S CONCRETE VIADUCTS

The floor system over each main arch is divided into three parts by four transverse expansion joints, two adjacent to each pier and one at each of the quarter points of the span. The floor is drained by down spouts through all spandrel walls, excepting those at the two intermediate expansion joints, and the drainage is discharged into the openings between the two ribs of the main arch. The drainage is prevented from flowing over the expansion joints by dikes built across the floor.

The waterproofing proper was done by using three plies of Minwax saturated cotton fabric laid in Minwax hard waterproofing. The concrete was first mopped with the Minwax hard waterproofing, applied hot. The three layers of cloth were then laid in the usual manner, each layer being mopped before the application of the succeeding layer. This waterproofing was carried up the sides of the parapet wall to the top of the ties and directly across all expansion joints, so that the waterproofing was in reality continuous from one end of the bridge to the other. At the expansion joints one additional layer of the saturated fabric was laid across and folded in the expansion joint beneath a copper flashing, similarly laid, over which the three layers of waterproofing were placed. A fold was provided in the waterproofing at the joints to provide for expansion, and the entire joint filled with the Minwax hard waterproofing, poured hot. Detail of this expansion joint is illustrated on the accompanying sketch.

As a protection to the waterproofing, the Johns-Manville asphaltic mastic, mixed with torpedo-washed gravel, was applied hot in $2\frac{3}{4}$-in. layers over the entire area of the waterproofing. In order to avoid injury to the waterproofing by the hot mastic one ply of Johns-Manville asbestos felt was first laid over the entire area of the waterproofing. An opening was left in the mastic directly over the center of each expansion joint. This opening was filled with the Minwax hard waterproofing compound. The Johns-Manville asphaltic mastic was used for protection in preference to brick or concrete, since our experience elsewhere with this mastic, under ballast, indicates that it does not crack and in reality forms a secondary waterproofing surface on which the drainage readily passes to the down spouts.

G. J. RAY,
Chief Engineer D. L. & W. R. R.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Edging Tool for Concrete Roads Easily Made on Job

AN EDGING tool to give a 3-in. circle on a concrete road is hard to find in a store. Samuel Hobbs, field engineer of the Massachusetts Highway Commission, in a paper presented at the March convention of that commission, described a method of making one which could be easily followed by the average job blacksmith.

A 12 x 7-in. piece of sheet iron should be heated, and one edge rolled to a 3-in. quarter circle over a wooden form. The metal should be clamped in this shape until cooled. A handle may be attached to the upper side, and the edge which is to touch the side form may be ground thin on an emery wheel.

Handy Forms for Balustrade

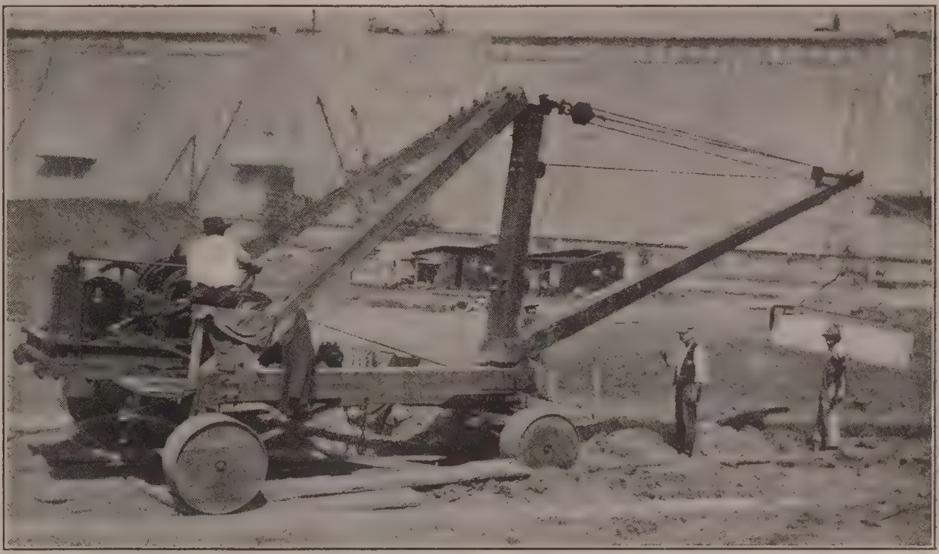
FORMS fitted together so as to stand under the pressure of the concrete without much nailing, and which were therefore easy to remove and re-erect, were used in making the balustrades on the Olympic Island bridge at Toronto, described by L. M. Edwards on page 547 of the Engineering Record for April 22, 1916. The side pieces were held apart by blocks at the top and bottom and by two other blocks in the center with a wedge between them. After the concrete had been poured and one side form removed, these blocks and wedges could be quickly taken out, releasing the whole form.

BALUSTRADE FORMS NEED LITTLE NAILING

Home-Made Machine Sets Concrete Curbing in Soft Ground

By RICHARD R. BRADBURY
East Pleasantville, N. Y.

THE wide-tired traveler shown in the accompanying photograph was made on the job to place more than 20,000 lin. ft. of concrete curbing on ground, much of which was too soft for loaded wagons, in the park below the Kensico Dam of the Catskill Water Supply near New York City.



HOME-MADE WHEELS WITH 14-IN. TIRES USED ON DERRICK THAT SET CONCRETE CURB IN 1300-POUND SECTION OVER 25 ACRES OF SOFT GROUND

This curbing was cast in short lengths in the same yard with the concrete blocks for the dam, and was all set by the small derrick. The area over which the work was distributed was about 25 acres, part of which was readily accessible to wagons and over the rest of which the ground was often too soft for teaming. The sections of curbing averaged about 6 ft. in length and weighed about 1300 lb. apiece, so that a large derrick was not needed. The machine was built of such material as was on hand, however, and was heavier than necessary, being able to handle 9 tons.

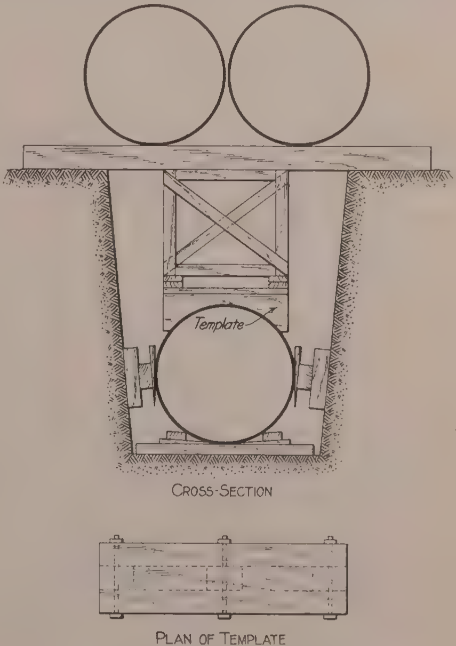
The stiffleg derrick was built of 10 x 10-in. timbers with a 9-ft. mast and 25-ft. boom. The hoist was double-drum, driven by a 15-hp. electric motor. No swinging gear was used, the boom being swung with a tag line. Derrick and hoist were mounted on a wagon frame which was originally fitted with ordinary wide-tired wagon wheels. These did not prevent the machine miring and were changed for solid wooden wheels with iron tires about 14 in. wide.

The sections of curbing were hauled from the block yard in wagons and unloaded in small storage piles as near the derrick as practicable. From these small piles they were snaked by the derrick as needed for distances of 300 ft. or more. The derrick could set about six lengths of curbing without moving. It then pulled itself forward by a line anchored ahead until it was in position to set six more lengths. It was guided when moving by two men at the wagon tongue.

The gang employed in setting curb with this machine was usually made up of one carpenter foreman, one hoist runner and two laborers. They averaged about 150 lin. ft. of curb in an 8-hr. day. The dam is being built by H. S. Kerbaugh & Company, Inc., for the Board of Water Supply.

Pipe Lengths on Light Bents Hold Mains Down During Tests

WATER mains under test have to be kept from pulling apart longitudinally, rising vertically and creeping sidewise. The longitudinal movement is prevented by the



CROSS-SECTION

PLAN OF TEMPLATE

WEIGHT OF PIPES HOLDS MAIN DOWN

same bracing that holds the cap on. Sidewise movement can be easily prevented by blocking and wedging the pipe in between the opposite banks, which are usually quite close.

To prevent the vertical movement some contractors backfill high over the normal top of the trench. This method does not serve well if the test pressure is high, and, in any case, is wasteful, as the trench usually has to be re-excavated for quite a length to permit the removal of the cap and the continuance of the line. Another way is to load extra pipe lengths on the main under test, using supports erected according to the individual judgment of the handy-man or calker who happens to be doing the work.

A systematizing of the latter method—or an adaptation of the two if the test pressure is especially high—will save the water main contractor money if there are sufficient test sections on his job to warrant it.

A supporting platform can be made by sawing two 4 x 12-in. planks as templates, cross-connecting them securely and nailing a 2 x 12-in. plank on them. Two of these platforms should be provided, one for each end of the pipe. If it is intended to leave the main under test uncovered for more than one length, enough should be provided to carry back as far as the main has a tendency to rise. Light bents should be constructed sufficiently strong to sustain the load that may be put upon them, and of a height determined by the average depth of trench.

The templates should be set down on the main and the bents placed on them and secured by plank straps lightly spiked. Squared timbers are then laid on top of the bents parallel to the trench, and skids resting on the bank on each side placed on the timbers. Extra pipes can then be rolled onto the skids, using as many as are needed to obtain the desired weight, and wedged in place. The whole weight does not need necessarily to rest directly on the pipe—in fact, it is desirable that it should not. It should rest mainly on the banks, but the bents should be fitted in so snugly that to rise at all under the pressure the main would have to lift the entire weight. In the case of an exceptional trench depth the height of the tops of the bents could be adjusted to suit by blocking up. If when actually under pressure the main shows a tendency to rise despite the weight of all the pipes that can find a place on the skids, dirt to the amount required to overcome the tendency can be shoveled on it. This will occur only under a very heavy test pressure.

The advantage of this method lies in the fact that the greater part of the work is done at one time and not repeated. Once the templates and bents are built it is simply a case of blocking to suit. The method is reduced to a rule-of-thumb process. The units will be light enough to be handled and hauled from point to point without difficulty, and there need be no timber butchering. Another advantage is that the contractor need not waste labor placing a weight that is more than is required. He can roll on such pipe as he thinks are necessary. A water main, under test, does not jump suddenly out of a trench. It slides up slowly. If the man observing notices a tendency to do so he can have more weight rolled on as needed.

Steam Rollers Travel Slowly—Motor Truck Will Hasten Trip

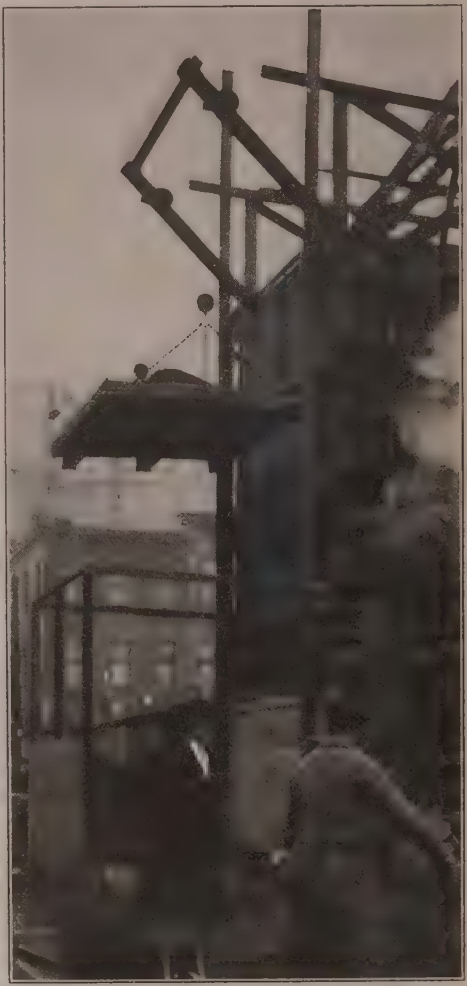
STEAM rollers are slow travelers. On road work much time has been wasted and the work delayed while the roller was journeying from one distant point to another. The Kelly-Springfield Steam Roller Company hauls rollers from the plant to the railroad yards for shipment on a 3½-ton Kelly-Springfield motor truck, having found this a much quicker way than to drive the roller under its own power. This method could be followed to advantage by road contractors if the distance is great enough to justify it.

HAULING STEAM ROLLERS BY MOTOR TRUCK QUICKER THAN RUNNING THEM BY OWN POWER

Loading a steam roller on to a motor truck on the job, however, is a more difficult matter than it is to load it at the shop, but the difficulty can be easily overcome. Most platform trucks are equipped with winches, either motor-operated or hand-operated. One way to get the roller up would be to place inclined skids at the tail of the truck, and draw the roller up with the winch. Another method would be to run the roller up on the bank—which is quite frequently a feature of the general run of country roads—under its own power and drive it along, laying down planks to facilitate its journey over the soft ground to a point where the bank is somewhat higher than the truck platform. Skids could then be laid down over the intervening gap and the roller easily placed on the truck. These are but two suggestions. Confronted with the task of doing such a job the average truckman would quickly devise a good method.

Tilting Platform Puts Material Into Elevated Bins

FOR GETTING material into an elevated storage bin the contractor for the new Plankington Hotel, Milwaukee, is using a simple home-made platform which, when elevated, dumps automatically into the bins. After the dump wagons have driven over the platform and dumped their loads, cables from a hoisting engine are attached to each end and the skip raised until the side nearest the bins strikes the overhead hoisting frame which extend at an angle of 45 deg. This frame is hinged at its lower side to the bins. As the platform strikes the frame both move to a vertical position, discharging the material into the bins. The William J. Hoy Company is contractor for the hotel.



SUPPORTS FOLD TO VERTICAL POSITION

Lumber Exhibit Sent to Paris

As a means of attracting trade in the era of reconstruction after the war, timber models of buildings which can be built advantageously with wood have already been shipped to Paris, for exhibition, by the Southern Pine Association. This group of miniature buildings was prepared by the National Lumber Manufacturers' Association in Chicago. It includes cross-section models of a mill-constructed building, house, barn, silo, and small farm buildings.

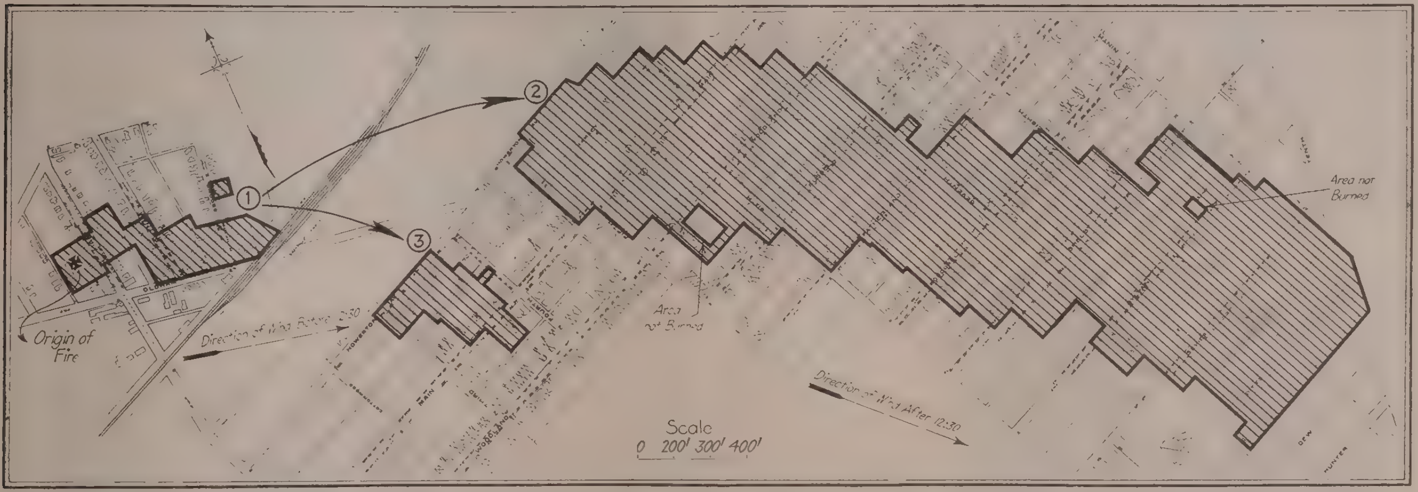
NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Fire Jumps 1800 Ft. Across Low Lands at Nashville

Sixty-six-Mile Gale Spreads Flames with Remarkable Rapidity Due to Shingle Roofs—Nearly 650 Buildings Destroyed

The fire which recently destroyed a large part of the residential district of Nashville, Tenn., as noted in last week's issue, was remarkable for the rapidity with which it spread, as well as the shape of the area covered. The flames, which started in a group of small frame houses, the location of which is shown on the map, were whipped into a roaring conflagration by a 66-mile northwest gale. Burning shingles were carried 1800 ft. across an unoccupied area, frequently flooded by the waters of the Cumberland River, near the tracks of the Louisville & Nashville Railroad, to point 2 on the diagram. A path 1250 ft. wide and 2¼ miles long was burned through this second district, the most valuable residence section. The fire at the third point was caused by shingles blown in that direction when the wind changed.



INDICATING THE POINT WHERE THE FIRE STARTED AND THE THREE SECTIONS OVER WHICH THE FIRE SPREAD. NOTE THE LONG DISTANCE BETWEEN POINTS 1 AND 2 OVER WHICH BURNING SHINGLES WERE BLOWN

Well Equipped to Fight Fire

The velocity of the wind at 10.30 a. m. on March 22, the day on which the fire started, was 66 miles per hour, from the northwest. The lowest velocity during the fire was 44 miles. Despite the fact that no rain had fallen for several days, the fire in the first district was easily confined to about 33 small houses because the facilities for fire fighting were excellent. The water pressure was 94 lb. per square inch.

When the fire spread to the second district, which is heavily outlined on the map, the fire department abandoned all hope of doing more than confining the blaze to a narrow path, and that they did this successfully is shown by the outline of the burned area.

Flames Spread Rapidly

Approximately 648 buildings were destroyed, of which 229 were servant houses, garages and stables of frame construction, and 419 were stores, churches, schools and dwellings, of which 159 were of frame construction with shingle roofs, 180 were frame construction with fire-resisting roofs, one was brick with shingle roof and 79 were brick with fire-resisting roofs. The estimated loss, as noted in the issue of April 22, was $1,500,000. The reconstruction of small residences has already been started.

This information was furnished by Robert H. McNeilly, assistant professor of civil engineering at Vanderbilt University.

Side Track Bankhead Road Bill

The Bankhead good roads bill, which was recently under consideration in the U. S. Senate, and provided for the appropriation of $75,000,000 to be used for road building, with an equal amount contributed by the states, was finally put aside April 21, without reaching a vote. Under the recently adopted legislative program, the measure will be displaced by the rural credit bill and it is believed that there will be no roads legislation this session.

Engineer Urges Creation of New Government Department

In a recent address before the Engineers' Society of Western Pennsylvania, at Pittsburgh, Isham Randolph, consulting engineer, of Chicago, dwelt upon the desirability of creating a new department of the government to have charge of all the public works other than those of a military nature. He pointed out that at present the government public works, other than those of fortifications, are divided among four departments, causing a loss of efficiency and economy.

Mr. Randolph stated that the time is at hand when the full services of every army officer are needed for national defense work and that the other works, such as improvements of rivers and harbors, should be undertaken by civilians who could devote all of their time without danger of being transferred frequently.

Los Angeles Incinerator Damaged

It has been reported that an explosion at the operating plant of the municipal refuse incinerator at Los Angeles did damage amounting to $250,000.

May Rebuild Dam at San Diego

A survey has been made by the San Diego (Cal.) engineers located at the dam at Lower Otay, with a view to the reconstruction of that structure.

Seattle's New Port Improvements Overtaxed

Facilities Considered a White Elephant Last Year Are Now Used to Capacity—War Business with Russia the Cause

(Editorial Correspondence)

Some of the commerce which has been kept off the Atlantic by war conditions has reached a destination in the Eastern Hemisphere by traveling west. Seattle has advanced in a few months to a much more important distributing point than ever before. The total value of exports consigned to Russia and transshipped from Puget Sound in January was about $2,000,000. In February this suddenly increased to $12,000,000. Several lines of Japanese steamers have pressed into this service every available vessel, and these, together with steamers of Russian, American and British registry, the tonnages under each flag varying in the order of listing, are now making rush trips to deliver freight as speedily as possible to the Siberian railroad terminal and to Oriental ports generally.

Smith Cove Dock Crowded

When the Smith cove dock, which is 1710 ft. long, 300 ft. wide, and has 2½ miles of railroad trackage, was completed by the Seattle Port Commission last year, there were those who referred to it as a white elephant. It is significant that this dock has recently turned away business. The same condition has, in general, obtained all along the Seattle waterfront.

Moreover, though the proposition to construct a municipal belt-line railway did not receive the necessary two-thirds vote at the recent election, it did receive a majority.

Other Activities

In addition to heavy overseas traffic, three other elements are contributing to Seattle's waterfront activity—Alaska copper, shipbuilding and lumber. In 1914 copper to the value of almost $3,000,000 came from Alaska to Puget Sound ports. In 1915 this business increased at one bound to more than $12,000,000, and this year it is confidently expected that the value of copper shipped from Alaskan mines will be $25,000,000, more than double the value of the amount shipped the previous year.

Views of Burned Parts of Nashville

UPPER LEFT—WOODLAND STREET PRESBYTERIAN CHURCH. UPPER RIGHT—THE RUINS AT SIXTH AND RUSSELL STREETS. LOWER LEFT—WHAT REMAINS OF THE WARNER PUBLIC SCHOOL. LOWER RIGHT—THE HOME OF THE LITTLE SISTERS OF THE POOR WAS WRECKED. IN ALL, 648 BUILDINGS WERE DESTROYED BY THIS REMARKABLY RAPID FIRE

The shipbuilding industry has experienced a great boom. The Seattle Drydock & Construction Company has under way three large ocean steamers and it is reported that two newly organized Seattle firms have contracts for six more.

The lumber industry is to a certain extent as much of an index of local conditions in the Northwest as the steel market is of conditions in Eastern manufacturing centers. The extremely dull times of a few months ago are past, many of the lumber camps are active and more are rapidly opening up.

In short, the chief problem the Puget Sound district now faces is entirely opposite to that of a year ago. Then, depression reigned and engineering developments, such as they were, were made in the face of conditions. Now, everything invites expansion, and the main question is as to the magnitude of the improvements which will be justified by the percentage of the enlarged trade which will be retained after conditions on the Atlantic are normal.

New York City's Bridge Department Bill Passed

The passage of the bridge department bill which, as noted in the April 15 issue, will save the city of New York over $1,000,000 a year by reorganizing the present bridge department under the name of department of plant and structures, passed the Senate April 17 by a vote of 28 to 15, and was passed by the Assembly April 20.

Washington Engineers Meet May 1 to Discuss Road Building

The first road builders' institute in the state of Washington will be held at the University of Washington, Seattle, May 1 and 2, at which time authorities on technical phases of highway construction will address county commissioners, engineers and road supervisors.

To Gather More Data on Los Angeles Sewage Problems

The board of supervisors of Los Angles county has decided to retain the commission of sanitary engineers for another two months and to instruct them to compile the following additional data: What degree of purification of sewage is necessary before the effluent can be used upon land for irrigation, without being a nuisance or a danger to health; how much purification is necessary before the sewage can be discharged into the ocean without damage or danger, and just what degree of success has been attained in these two methods of disposal in other cities of America.

The commission was also asked about the necessary distance of sewage-disposal plants from residences, the process for reducing and purifying sewage, and several similar matters. The final question which the commission is expected to answer is whether or not the contemplated plant to be established near Ramona Acres, by Pasadena, South Pasadena and Alhambra, will accomplish the desired results without becoming a nuisance.

Extensive Grade Separation in Kenosha, Wisconsin, Ordered

The elimination of practically all of the important grade crossings in the city of Kenosha, Wis., is called for in an order issued April 20 by the Railroad Commission of Wisconsin. The order specifies that the main tracks of the Wisconsin division of the Chicago & North Western Railway shall be elevated from a point south of Selma Avenue in the town of Mount Pleasant, which is south of the city limit, to a point north of the city limit in the town of Somers. All of the grade crossings on this division will be eliminated, and subways will be provided at fifteen streets. In addition there will be pedestrian subways at three points. The tracks of the Kenosha line are to be elevated from the junction with the main line westward to Ridge Street, and on this line a subway will be provided at Fremont Avenue.

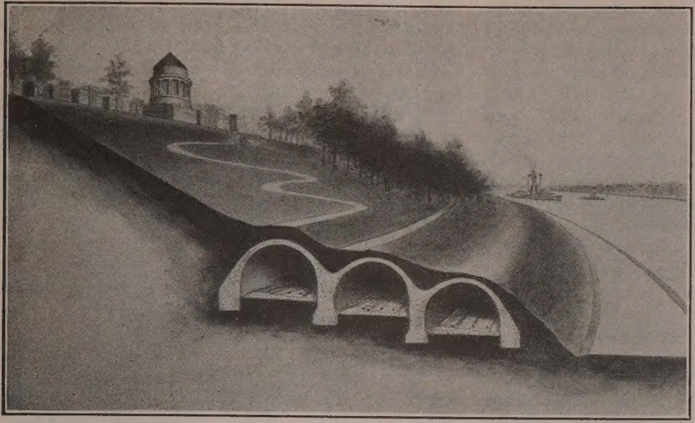
The yard at Main Street is to be depressed, and a viaduct will carry the street over the depressed tracks. The lowering of these tracks and the building of the viaduct over them will necessitate the construction of a new bridge over the river or a change in the grade of the old bridge. The city has the option of building a new bridge or changing the old one.

The order provides that the work be started on or before July 1, 1917, and be completed by December 31, 1919. The entire cost will be about $1,600,000, exclusive of property damages. The railway company is required to bear the entire cost of all work within its right-of-way lines, and the city all work outside of the right-of-way lines. The street railway company is required to perform all work necessary in changing its tracks, including the necessary grading and paving, and in addition is required to pay a small sum to the city for its share of the cost of the work on the bridge over the river, and another to the steam railroad as its part of the cost of the Main Street viaduct over the yard.

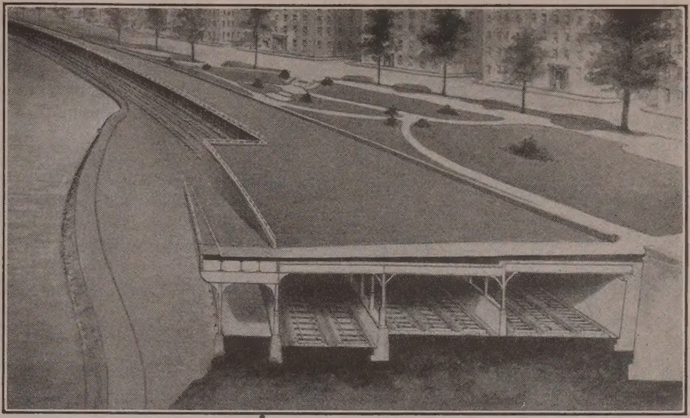
Efficiency League Formed to Promote Good Roads

To advance the interests of several municipalities and townships in that county, and bring about better co-operation, the Efficiency League of Cuyahoga County has been formed, with headquarters at Cleveland, Ohio. The league expects to promote good roads by offering prizes for the sections showing the greatest road improvements by the end of the coming season.

W. A. Stinchcomb, county highway superintendent, gave an instruction lecture on dragging earth roads at the second meeting of the league.



WHERE THE DEPTH IS AVAILABLE ARCHES WILL BE USED



AT OTHER POINTS, A FLAT ROOF OF STRUCTURAL STEEL

How West Side Tracks in New York Are to Be Covered

The accompanying sketches are representative of types of covering proposed for the New York Central freight tracks, in connection with the West Side improvement in New York City. (See the Engineering Record of April 15, page 528.) The flat structural steel construction is to be used most of the way along Riverside Park. Opposite Grant's Tomb, where the slope is steeper, and also under Inwood Hill, arches are to be employed.

The plans for the $50,000,000 project are now on file with the Board of Estimate and Apportionment of New York City, and the first public hearing on them will take place Monday, May 1.

President Asks Business Men's Co-Operation in Defense Plans

The Committee on Industrial Preparedness of the Naval Consulting Board recently made public a letter from President Wilson, addressed to the business men of the country, in which the President asks the business men to co-operate with the Consulting Board "for public service in national defense." The committee, as announced in last week's issue, is now organizing the industries of the country for use in case of war, and it is in support of that work that the President addresses the business men of the nation.

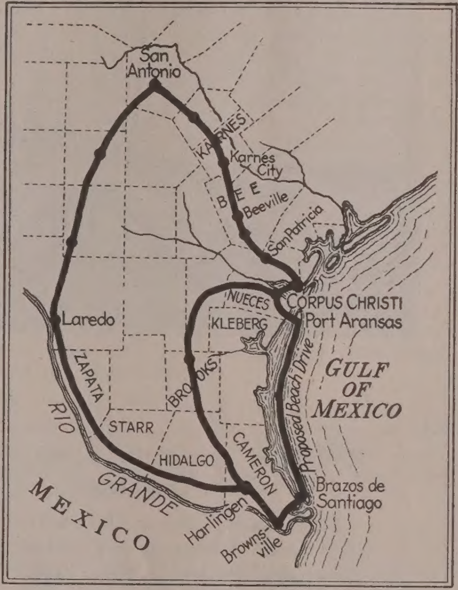
The engineers who will take the field on May 1 will be under the direction of state boards of five men each in every state, Alaska and the District of Columbia. These boards in turn are directed by W. S. Gifford, who is chief statistician of the American Telephone and Telegraph Company, who has been made footloose by his company for this work.

The work of the Committee on Industrial Preparedness is receiving the support of the President, the naval and military heads at Washington, and the Chamber of Commerce of the United States. In addition, the Associated Advertising Clubs of the World have undertaken, without cost to the government, a nation-wide advertising campaign in support of the committee's plans.

Chicago Engineers Crowd Hall to Hear Military Lectures

The course of lectures on military engineering, started in Chicago April 20, was a success beyond the expectation of its managers, the Joint Committee on Military Engineering. More than 300 engineers taxed the capacity of the hall at the Hamilton Club and listened with intense interest to the 1½-hr. illustrated lecture on "The Civilian Engineer and National Defense—Organization and Duties," by Lt.-Col. W. V. Judson, Corps of Engineers, U. S. A.

The main purpose of the lecture course, which also includes tactical walks, exhibition drills and visits to military posts, is to arouse the interest of engineers in military engineering. To this end, the practical feature of urging men to support various military organizations was not neglected, officers of the local companies being given an opportunity to speak about their own work.



PROPOSED 810-MILE TEXAS HIGHWAY IS RAPIDLY MATERIALIZING

Lt.-Col. George W. Burr, commandant Rock Island Arsenal, spoke April 27 on "Modern Ordnance." More than 400 enrolled for this lecture.

"Coast Defense—Its Problems and Their Adaptability to the Civilian Engineer" will be the subject of the lecture May 4 by Lt.-Col. Mason M. Patrick, Corps of Engineers, U. S. A., Detroit.

Over One-Third of 810-Mile Texas Highway System Completed

Over 354 miles of the 810-mile Diamond Loop Highway in Texas have been completed. The road, which will be of macadam throughout its length, will connect the cities of Corpus Christi, San Antonio, Laredo and Brownsville. It will be 30 ft. in width.

Bond issues have recently been voted to a total of $215,000 by the Aransas Pass district and Starr, Brooks and Zapata counties for the completion of further links. Elections have been called to vote on issues amounting to $260,000 by Hidalgo County and Port Aransas, and elections are being considered for $325,000 more by Nueces, Kleberg, Cameron, Bee and Karnes counties.

From Laredo to San Antonio the road is almost completed, and from the former city to Zapata it is said to be in excellent condition.

Engineers and Lumbermen Discuss Douglas Fir

Selecting Douglas fir structural timber according to fiber quality was considered at a recent conference between technical engineers and lumbermen held in the offices of the West Coast Lumbermen's Association, at Seattle. The engineers participating were, for the most part, members of Committee D-7 of the American Society for Testing Materials. Hermann von Schrenk, consulting timber engineer, of St. Louis, Mo., and John A. Newlin, in charge of timber testing at the U. S. Forest Products Laboratory, Madison, Wis., were prominent in the discussion.

The society aims to develop specifications for Douglas fir. This material, it was stated, is rapidly coming into increased use, particularly in the East, and a vigorous demand has arisen, both among engineers and architects, for more accurate descriptions of what constitutes the best quality.

Dodo Creates Interest in Preparedness

THE JOINT COMMITTEE ON MILITARY ENGINERRING, AT CHICAGO, WHICH ORGANIZATION IS CONDUCTING AN ACTIVE AND AGGRESSIVE CAMPAIGN FOR MILITARY PREPAREDNESS, PLACED THE BIRD SHOWN IN THE PICTURE AT A PROMINENT PLACE IN CHICAGO STREETS TO ADVERTISE ITS MILITARY LECTURES. THE COMPLETE CAPTION READS: "DODO, THE ORIGINAL PACIFIST, COULDN'T FIGHT, COULDN'T FLY, COULDN'T RUN. UTTERED A CRY LIKE A GOSLING."

New Jersey Sewage Works Association Discusses Problems

Methods employed by various cities for keeping trash out of sewers were pointed out by Frederick T. Parker at the first meeting of the New Jersey Sewage Works Association, April 18, at Plainfield, N. J., and in the discussion which followed, the removal of grease from sewers, and its disposal, were also considered. An instance cited was the situation in Atlantic City, where, it is estimated, 10,000 barrels of grease could be collected every year if the ordinance requiring the installation of grease traps could be enforced.

I. Z. Collings, of Collingswood, showed that the life of a sewer connection in a yard containing a weeping willow tree was one year. He also described the collection of gas from a separate digestion chamber at Collingswood, saying that in 24 hr., with a 4-ft. gas bell, he had collected sufficient gas to run his 10-hp. engine for 19 min. The 36 ft. of gas collected did the work of 38 ft. of gas from the regular source of supply.

Change Method of Supervising New York Subways

By a unanimous vote, the New York Senate, April 17, passed the Thompson committee bills, amending the public service law and taking from the Public Service Commission, supervision of the construction of New York City subways and elevated railways.

The measure provided that after the board of estimate has decided upon a subway, the Public Service Commission shall turn over to a commission to consist of one member from each borough, with the mayor and controller serving as members ex-officio, all supervision of construction. The bill is a direct out-growth of the investigation of the Public Service Commission conducted by the Thompson committee.

Export Company Sending Engineers to Russia

To study the needs of the Russian markets for contractors' equipment, factory requirements and all kinds of machinery with which engineers have to do, R. Martens & Company, Inc., of New York, are sending sixteen engineers into various parts of that country, each accompanied by a Russian engineer. At present these men are going through factories in the United States.

They will travel in pairs during the summer and return to Russia in the fall, said Richard Martens, a Russian, who is vice-president and director of the company. He also outlined the opportunities for Russian export business, but cautioned exporters not to insult the Russian buyer by using methods not allowed here. Mr. Martens' firm is now receiving, and storing, ten motor trucks a week of from 3½ to 5-tons capacity for delivery after the war is over.

Seattle Engineer Urges Water Power Development in U. S.

Immediate steps to pass such legislation as will protect investment in water power development and make the terms of lease and profit fair and liberal in order to attract capital in this direction were urged by Henry J. Pierce, consulting engineer, of Seattle, in a recent address on "War and Water Power," given before the Chicago Association of Commerce. The water power available in this country amounts to 61,000,000 hp., of which, according to Mr. Pierce, only 10 per cent is now being used, while the greater part of the 35,000,000 hp. of Europe is already developed.

Besides being a great economic saving, making possible the irrigation of vast lands now practically untouched and the creation of new industries in the cities, the development of this power will make possible the utilization of cheap electrical energy for extracting nitrogen from the air and converting it into fertilizer and nitric acid. The United States is almost completely dependent on the sodium nitrate deposit in Chile for the nitric acid used in the manufacture of ammunition, and imports 625,000 tons of nitrate a year from that country at a cost of $21,000,000, of which $7,500,000 is duty to the Chilean government. In the present situation of Germany our country would be helpless. However, that nation, with its great hydroelectric developments, can secure the necessary nitrogen from the air.

Half of Longest Bore in Twin Peaks Tunnel Is Completed

The 12,000-ft. bore in the Twin Peaks tunnel, at San Francisco, which is under Twin Peaks proper, is nearly half completed and the hardest part of the excavation is said to have been accomplished. The situation, as outlined in a report from the city engineer's office, is as follows:

"The red rock and cherts which cover the surface of Twin Peaks and which were found in the early part of the excavation, are now rapidly changing to a sandstone like that in the Laguna Honda quarry. It is safe to assume that this class of sandstone will be in the entire formation through the high portion of the hill, which will contribute considerably to the easy excavation of the structure.

"The last 46-ft. ring in the arch of the Laguna Honda station has been poured, and nothing now remains to be done but to construct the elevator pits and stairways, which will be rapidly poured in the coming weeks. Also the southwesterly portion of the tunnel up to the station will be completed before May 10.

"At the ventilator drift near the north boundary of the Relief Home tract there is still a constant flow of 325,000 gal. of water daily, which has been lifted by pumps to the surface. A pilot has been excavated to the Laguna Honda station to drain the formation so as to expedite the work of completing this portion of the tunnel.

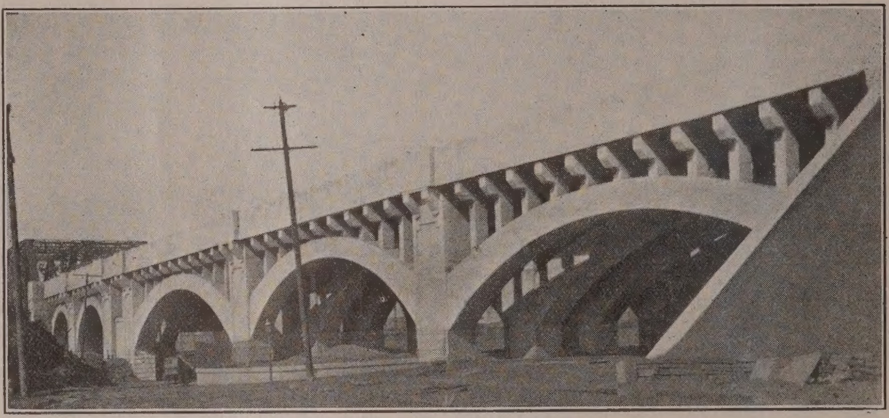
"Practically all the serious problems in connection with the structure have now been solved and nothing remains to be done but to excavate the straight section of the tunnel. Due to the hard sandstone rock that has been encountered, the previous heavy lining will undoubtedly be diminished."

New Garbage Plant for New York on Staten Island

The Board of Estimate and Apportionment of New York City recently approved a contract for the erection of a garbage disposal plant at a site on Staten Island, and the award has been made to Gaffney, Gahagan & Van Etten. The works will receive the garbage of the boroughs of Manhattan, The Bronx and Brooklyn. The Board of Aldermen, on March 7, defeated a resolution authorizing the construction of a plant on city-owned land at Riker's Island, this installation being recommended by Commissioner John T. Fetherston of the Street Cleaning Department.

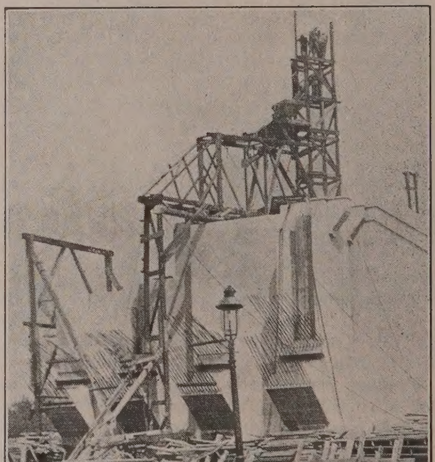
Under the terms of the contract for the Staten Island plant, the contractor is to erect the works on private land and make payments to the city aggregating $900,000 during the five-year term covered by the contract.

The works will have a capacity of 2000 tons daily and will employ the Cobwell process of disposal. While the Staten Island plant was not considered by Commissioner Fetherston to be the best one for the city it was recommended as a last resort, because the city's present contract with the operators of the Barren Island plant terminates at the end of this year and immediate provision for the future is necessary.



Bridge at Ninetieth Street, Cleveland, Completed

THIS BRIDGE IS A RECENTLY COMPLETED STRUCTURE AT EAST NINETIETH STREET ON THE CLEVELAND & YOUNGSTOWN RAILROAD, A RAPID-TRANSIT LINE BEING BUILT TO CONNECT A RESIDENTIAL SECTION OF THE CITY OF CLEVELAND WITH THE BUSINESS DISTRICT. THE STEEL SPAN IN THE BACKGROUND IS OVER ANOTHER RAILROAD, WHERE HEADROOM WAS LACKING.



Estimates to Be Made for Yuma, Ariz., Irrigation Project

L. M. Lawson, manager of the Yuma project, has received instructions to begin the survey upon which the U. S. Reclamation Bureau can base estimates for the cost of pumping and power plants in connection with the irrigation of what is known as the Yuma mesa unit of the project. Actual construction is expected to begin about Oct. 1.

Engineers May Attend Military Encampments Without Loss of Pay

The Public Service Commission for the First District, New York City, has adopted a rule which will permit its employees to attend military encampments for practically four weeks without loss of pay.

Demand for Engineers Increases

A news note headed as above appeared in the April 22 issue in which it was stated that "over fifty desirable jobs are advertised on the bulletin boards of Pennsylvania University." The institution referred to should have been the Pennsylvania State College.

News of Engineering Societies

The Western Society of Engineers will hear Capt. H. B. Sauerman talk on "Fortification," May 1.

The Engineers' Club of Trenton, N. J., at a meeting April 27 heard C. C. Creighton, mechanical expert of the Galena-Signal Oil Company lecture on the history and development of the oil industry.

The Engineers' Club of St. Louis has arranged for A. G. Allen, assistant engineer in the valuation department of the Missouri Pacific Railway, to speak on "A Railroad Reconnoissance through the Hudson Bay Country" at a meeting April 26.

The Municipal Engineers of the City of New York held a meeting in that city April 26, at which James Sanborn, division engineer of the Board of Water Supply, presented a paper on the preservation of boring records and underground data.

The Engineers' Society of Western Pennsylvania will hold a series of military lectures, the first of which will be given May 3 by Lieut.-Col. Francis R. Shunk, on the subject of "The Organization and Duties of Engineer Troops." The meetings are to be held in Carnegie Music Hall, Pittsburgh.

Personal Notes

C. R. ANDERSON, supervisor of the Mahanoy and Hazleton division of the Lehigh Valley Railroad, has been appointed division engineer, with headquarters at Hazleton, Pa. He succeeds J. F. Donovan, who is transferred to the Auburn division.

M. V. HAAS, U. S. junior engineer, recently in charge of the U. S. engineer's office at Brunswick, Ga., has been promoted to a similar position at San Juan, Porto Rico. From 1907 until 1910 Mr. Haas was employed by the U. S. engineer office at Manila, after which he was connected with lock construction work at Dallas, Tex., and later was engaged in flood protection work for the engineering department of Cincinnati, Ohio. He again entered the service of the government in 1914, with headquarters at Brunswick, Ga., where he was stationed until his recent promotion.

LYNN CRANDALL has resigned from his position as assistant engineer of the U. S. Geological Survey, at Salt Lake City, to become chief hydrographer of the Twin Falls North Side Land & Water Company, of Jerome, Idaho, where he will have charge of hydrometric investigations.

SAMUEL V. SPRY, formerly assistant in the office of the Utah state engineer, has resigned to accept a position at Washington in the government consular service. Mr. Spry was formerly with the consular service in Hungaria.

HALFORD ERICKSON, chairman of the Railroad Commission of Wisconsin, and regarded by many as one of the leading thinkers among state commissioners, has resigned from the commission.

FRANK L. WHEATON has been promoted from the position of engineer of construction for the Delaware, Lackawanna & Western Railroad, to that of division engineer, with headquarters at Binghamton, N. Y. Mr. Wheaton was graduated from Dartmouth College in 1886 and immediately thereafter accepted a position as resident engineer for the Chicago, Rock Island & Pacific Railway. He remained in the service of that road until 1889, when he went to the Lehigh Valley Railroad as assistant engineer. In 1890 he engaged in private business, but again took up railroad work in 1898 as resident engineer for the Chicago & Northwestern Railway. He remained with this road until 1900, when he was appointed assistant engineer for the Delaware, Lackawanna & Western, at Hoboken, N. J. He spent 1902 and 1903 as resident engineer for the Pittsburgh, Shawmut & Northern but returned to the Lackawanna in 1903 as engineer of track elevation at Newark, N. J. Mr. Wheaton was terminal engineer for that road, at Hoboken, during 1904 and 1905, and since then has located the Hopatcong-Slateford and the Nicholson cut-offs. He was also resident engineer of the Bergen tunnel and had charge of the construction of the Hopatcong-Slateford and the Nicholson cut-offs.

W. W. MOREHOUSE has resigned from his position as county engineer for Marshall County, Iowa, to accept an appointment to a similar position for Polk County, with headquarters at Des Moines.

EDMUND T. PERKINS, consulting hydraulic engineer, of Chicago, addressed the civic-industrial section of the Chicago Association of Commerce, April 21, on "Our Undeveloped Resources."

AMOS SCHAEFFER, consulting engineer in charge of sewers for the Borough of Manhattan, has been promoted to the position of consulting engineer for that borough, succeeding E. P. Goodrich. The position formerly held by Mr. Schaeffer will be abolished and the work divided among other city officials. Mr. Schaeffer was born in 1867, at Fleetwood, Pa., and was educated at Franklin and Marshall College and at Sheffield Scientific School. He was in the employ of the Lehigh Valley Railroad for two years and from 1894 until 1897 was assistant in the office of the city engineer of Niagara Falls. In the latter year he was appointed topographical draftsman for New York City, in the department of sewers of the Borough of The Bronx and was appointed consulting engineer for that borough in 1910. In 1914 he became consulting engineer for the bureau of sewers of the Borough of Manhattan.

CHARLES SAVILLE, formerly director of sanitation for the city of Dallas, Tex., has just been promoted to the position of director of public health, in which capacity he will have complete charge of all city matters relating to his department. Mr. Saville was graduated from Massachusetts Institute of Technology in 1906 and for four years thereafter was connected with the Massachusetts Board of Health. From May, 1910, to September, 1911, he spent in Europe studying municipal sanitation problems. Upon his return he became associated with the firm of Hering & Gregory, consulting engineers, of New York City, from which he resigned in 1914 to take up studies at the School for Health Officers of Harvard University and shortly after he became connected with the city of Dallas, Tex.

GEORGE C. ANDREWS has been appointed to fill the recently created position of supervising engineer of the bureau of water of Buffalo, N. Y. Mr. Andrews is a graduate of Lafayette College and was recently connected with the New York State Barge Canal as resident engineer at Lockport.

ROBERT H. LARGE, formerly general coal freight agent of the Pennsylvania Railroad, has been promoted to the position of coal traffic manager of that system. Mr. Large entered the railway field in 1895 as rodman in the maintenance-of-way department of the Pennsylvania and took up work in the freight department the following year, in which department he has risen to his present position.

WILLIAM GRANT, a member of the firm of Grant & Fulton, consulting engineers, of Lincoln, Neb., has been appointed associate professor of civil engineering, in charge of water supply and sanitary engineering, at the University of Nebraska. Mr. Grant was graduated from that university in 1897 and for ten years following graduation he was in the employ of the Chicago, Burlington & Quincy Railroad, was city engineer of Lincoln for three years and has since been in private practice. He spent two years, 1912-1913 and 1913-1914, at the Massachusetts Institute of Technology in special study along the lines to which his present appointment relates. He will continue his connection with the firm of Grant & Fulton.

DONALD M. COOK has resigned from his position in the engineering department of the village of Winnetka, Ill., to accept a similar appointment in the engineering department of Flint, Mich.

ERNEST P. GOODRICH, whose resignation as consulting engineer for the Borough of Manhattan was noted in a recent issue, was entertained at a luncheon April 20 given by the heads of the various municipal deparments. Over 60 city officials were present to show their appreciation of Mr. Goodrich's work.

B. H. TONG has been appointed to a position with the Armstrong Engineering Company, of Taylorville, Ill., and will soon take up his duties as assistant superintendent of construction for that company, with headquarters at Varilla, Ky.

ROY L. GREENE has resigned from his position as deputy county engineer of Lewis County, Wash., to accept an appointment as engineer in the fireproofing department of the Berg Manufacturing Company, of Canton, Ohio, with headquarters at Minneapolis.

H. BITTMAN, structural engineer, of Seattle, Wash., has removed his office to larger quarters in the new Washington Securities Building.

J. C. SMUTZ has been appointed engineer of Pawnee City, Neb.

F. O. DUFOUR has resigned as senior structural engineer of the Central District, Division of Valuation, Interstate Commerce Commission, to become associated with the Stone & Webster Engineering Corporation, with headquarters at Boston, Mass., effective May 1.

R. J. PALMER has been appointed resident engineer for the Norfolk & Western, at Norfolk, Va.

FRANCIS W. DU BOIS has resigned from his position as U. S. surveyor, at Little Rock, Ark., to enter into a partnership with Hobart L. Cory, to conduct a consulting engineering business at Baker, Mont.

THE TURNER CONSTRUCTION COMPANY, of New York City, has opened a branch office at 45 Milk Street, Boston, to handle the New England business of the concern. W. R. Sides will have charge and A. C. Tozzer will be general superintendent.

J. D. Cupp was recently appointed principal assistant to the city engineer of Lima, Ohio, and at present is devoting his time to making river surveys.

Francis M. Veatch will leave his position with the University of Kansas to become assistant engineer for the state board of health of Kansas. Mr. Veatch was graduated from the University of Kansas in 1913 and has been conducting investigations of sewage-disposal plants since then.

Reid Jones, formerly designing engineer for Bartlett & Ranney, Inc., consulting engineers, of Dallas, Tex., has resigned from that position to engage in consulting engineering practice with C. S. Thomas, Jr., of St. Louis. The firm of Thomas & Jones will engage in general engineering and contracting work, with offices in the Chandler Building, San Antonio, Tex.

Paul T. Cahill and Kyle W. Armstrong have formed a partnership for the practice of architecture and engineering, with offices in the Hippodrome Building, Cleveland, Ohio, under the firm name of Cahill & Armstrong.

William C. Atwater has left the employ of the Des Moines Bridge & Iron Works to become associated with the Four Wheel Drive Auto Company of Clintonville, Wis.

A. T. Thompson, formerly city engineer for Chippewa Falls, Wis., has resigned from that position to engage in the practice of consulting engineering in Stevens Point, Wis. Mr. Thompson was appointed consulting engineer for the latter city April 11 and will have charge of design and construction of paving and sanitary and storm sewers for that city.

Milo R. Maltbie of the advisory board of the Division of Valuation, Interstate Commerce Commission, has resigned to become chamberlain of the city of New York.

J. D. Galloway, consulting engineer, of San Francisco, is chairman of a committee on military engineering which proposes to carry out a series of events similar to those now being conducted in Chicago.

George S. Nickerson, formerly engineer for the North Fork Ditch Company, at Sacramento, Cal., has been advanced to the position of general manager and chief engineer.

I. E. Goodner, formerly of Aurora, Nev., is reported to have been appointed consulting engineer for the Paradise Irrigation project, at Chico, Cal.

George W. Fuller, consulting engineer, of New York City, has been retained to act in a consulting capacity for a local sewage disposal project at Phillipsburg, N. J., and not, as stated in the April 15 issue, for New York City. The firm has also been engaged to prepare preliminary plans for a sewage-disposal plant at Lima, Ohio.

Joseph R. Sterling, for the past eight years chief engineer of the Inter-Urban Railway Company and the Des Moines (Iowa) City Railway Company, has resigned from that position to become associated with the Des Moines Asphalt Paving Company, of Des Moines, Iowa.

Bion J. Arnold, consulting engineer, of Chicago, has been appointed a member of the naval consulting board, representing the American Society of Aeronautical Engineers, succeeding H. A. Wise Wood, who recently resigned.

P. O. Crawford has resigned from his position with the Afghanistan government, where he was employed on a hydroelectric installation, to take charge of the construction of a dam and hydroelectric plant for the California Oregon Power Company, near Hornbrook, Cal.

H. G. Roby has recently been appointed city manager for the city of Alpena, Mich. After graduating from Dartmouth College, he was with D. W. Mead, consulting engineer, of Madison, Wis., for some years, and later was superintendent of construction for the Oliver Mining Company, in charge of a water-power development on the Menominee River.

Robert A. Cummings, consulting engineer, of Pittsburgh, Pa., has been elected a member of the British Institution of Civil Engineers.

Samson K. Cohen has accepted a position with the Boston & Maine Railroad, at Roxbury, Mass., as structural draftsman engineer. Mr. Cohen was graduated from the Massachusetts Institute of Technology in 1910 and has since been connected with the American Bridge Company, the New England Structural Company, the Isthmian Canal Commission, at Culebra, and the Missouri Pacific Railway.

F. T. Morrissey has resigned from his position as superintendent of the light and water works at Winamac, Ind., to take effect May 1.

Obituary Notes

Charles E. Wickham, division engineer for the Delaware, Lackawanna & Western Railroad, at Binghamton, N. Y., died in that city April 16. He was born at Southampton, England, in 1863 and was educated at the Iowa State University. He entered the service of the Burlington, Cedar Rapids & Northern Railway as chainman in 1884 and in 1885 had risen to the grade of resident engineer and draftsman. He went to the Kansas & Colorado Railway in 1887 as office engineer and later in that year was appointed assistant engineer for the Chicago, Rock Island and Pacific Railway. He spent parts of the years 1890 and 1891 as topographer for the Mexican Southern Railway and returned to the Rock Island late in 1891 as assistant engineer, from which position he resigned the following year to become superintendent of construction for the Peoria Terminal Railway. In 1893 he again became connected with the Rock Island and was roadmaster for that road until 1897, at which time he was promoted to the position of division engineer, at Chicago. In 1901 he was made general roadmaster in charge of lines east of the Missouri River and his appointment with the Lackawanna followed shortly.

F. W. D. Holbrook, acting head of the department of yards and docks at the Puget Sound Navy Yard, died in Seattle, Wash., April 13. He was prominent in engineering circles, especially in the latter half of the last Century. Since that time Mr. Holbrook was resident engineer at the east end of the Hoosac tunnel. He became division superintendent of the Yellowstone division of the Northern Pacific Railway in 1886 and held the position of secretary for the Seattle Board of Public Works from 1890 to 1892. From the latter date until late in 1915 he was with the department of yards and docks, at the Puget Sound Navy Yard, being acting head of the department a great part of the time. During his long period of service he was prominently connected with the building and development of Western railroads. Mr. Holbrook was born in Boston, Mass., in 1840.

J. P. K. Miller, chief engineer for the H. C. Frick Coke Company, died April 9 at Scottdale, Pa.

John M. Buckminster, a retired civil engineer, of Boston, Mass., died in that city April 21. He was born in 1850 and received his education at the Lawrence Scientific School. Mr. Buckminster was associated with the constructon of waterworks at Lynn and Walden, Mass.

Charles H. Preston, engineer and architect, of Norwich, Conn., died at his home in that city April 20. Mr. Preston was for several years in the employ of McQuirk & Bacon, architects and builders, and later studied at Northwestern University, Chicago, after which he returned to Norwich to open an office. He was employed to assist in the design and construction of many local structures among which are the Thayer, Shannon and Majestic buildings, in Norwich. He also prepared plans for most of the buildings at Taftsville to replace those destroyed by the fire in that city a year ago.

John K. Brown, who retired in 1900 from active service as assistant engineer of maintenance-of-way for the Missouri Pacific Railway, died recently at Wichita, Kan. Mr. Brown was born in 1832 and entered railway service in 1856. He had been in the employ of several different roads previous to his association with the Missouri Pacific and had surveyed and helped construct part of the Oregon Short Line, as well as sections of the Missouri Pacific and the Boston, Hartford & Erie railroads.

James Malcolm Gleaves, chief clerk in the San Francisco office of the U. S. Surveyor General, died at Berkeley, Cal., April 14, at the age of forty-eight.

David H. King, retired builder, of New York City, died at his home in that city April 20. Mr. King was born in 1850 in the city in which he died and at the age of twenty entered the building business in which he later won success. He constructed, among other New York buildings, the old Equitable Building, lately destroyed by fire, and the Madison Square Garden. He was president of the New York Dock Company for eight years preceding his retirement from active business life in 1909.

Edward Kane, former superintendent of the Chicago water pipe extension department and trustee of the Sanitary District of Chicago since 1910, died April 24 in that city.

Robert J. Cunningham, recent state highway commissioner of Pennsylvania, died April 26 at his home in Sewickley, a suburb of Pittsburgh. Mr. Cunningham was born in 1860 at Elizabeth, Pa. He started work at the age of 16. He was elected controller of Alleghany county in 1902 and 1906 found him in the state senate, from which he resigned in 1908 to again become controller of Alleghany county. He was appointed state highway commissioner in 1915.

Civil Service Examinations

Massachusetts.—The Massachusetts Civil Service Commission will hold an examination for dredging inspector May 5 at Boston. The salary is $3 a day. Only citizens of the United States who have been residents of Massachusetts for the past two years may take this examination. Blanks and information may be obtained from the civil service commission, room 151 State House, Boston.

Examinations Previously Announced

Date		See Eng. Record
May 3	Transitman, salary $1,200 to $1,500, Philadelphia	April 1
May 4-5	Assistant engineer, salary $2,500, and structural draftsman, salary $1,200 to $1,500, Philadelphia	April 1
May 9	Valuation analysts, salaries $1,800 to $5,000; Interstate Commerce Commission	April 8
May 2	Engineer-physicist; salary $2,000 to $3,000; U. S. Bureau of Standards	April 8
May 6	Junior electrical engineer; salary $901 to $1,200; State of New York	April 8
Aug. 21-25	Second lieutenant of civilian candidates	April 1